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ORIGINAL ARTICLES

ANCHORAGE AND ATTACHMENT

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A REGULATING appliance is a mechanical device for exerting pressure upon a malposed tooth. In order to accomplish the result desired in orthodontic work, two important conditions must be considered, namely; the resistance which is to overcome the force and the point of attachment to the tooth where the force is to be delivered.

The resistance to overcome the force exerted by the regulating appliance is termed "anchorage." After the proper construction of a regulating appliance and the selection of the anchorage, there must be a suitable point of attachment in order that the force may accomplish some definite purpose. Considering the fact that anchorage is resistance to overcome an applied force, the point of attachment of the appliance to the malposed teeth is an entirely different matter and should not be confused with the anchorage or classified as being an anchorage, as has been done by some.

It is true that a regulating appliance must be attached to the point of resistance, and must also be attached to the malposed tooth in order that the force may be properly utilized. However, the resistance is an entirely different thing from the attachment, although in certain forms of construction of regulating appliances, the means of attachment of the parts of the appliances to the anchor tooth may mechanically increase the resistance of the anchorage. Anchorage has been classified in various groups, first as *intra-oral* and *extra-oral* anchorage, which forms are designated by the resistance being selected, either from a point inside or outside of the oral cavity. Intra-oral anchorage is later divided into *intramaxillary* and *intermaxillary* anchorage, depending upon whether the resistance is in the same arch as the malposed tooth or whether the resistance is in the opposite arch from the malposed tooth. These anchorages

can be further classified according to mechanical construction as *simple anchorage* and *stationary anchorage.*

Simple anchorage is that form, in which the resistance is obtained from purely anatomic conditions, such as the size, and favorable location of the anchor tooth to which the appliance is attached. Fig. 1 may be considered as an example of *simple anchorage,* because the resistance to the regulating appliance is obtained from a canine and premolars. A large number of teeth have been pitted against one tooth supposing that the greater number of teeth would exert sufficient resistance to overcome the force necessary to produce such cell activity around the malposed tooth as would allow it to assume a normal position. In simple anchorage, we depend entirely upon the anatomic surroundings of the teeth selected as points of resistance, and do not construct our regulating appliance with the view of assisting those teeth whatsoever.

Stationary anchorage is that form in which the resistance necessary to overcome the force exerted on the malposed tooth is obtained by so constructing and attaching the appliance that if the anchor tooth moves at all, it must be moved bodily through the process. As a matter of comparison, in stationary

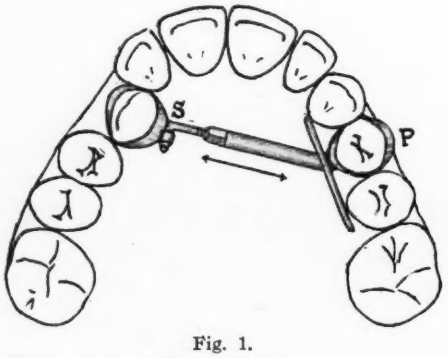

Fig. 1.
(After Pullen.)

anchorage the appliance must possess two things that are not necessary in simple anchorage; it must be so constructed and attached to the anchor tooth that if the anchor tooth moves at all it must move bodily. Stationary anchorage possesses the mechanical conditions which I have outlined plus the anatomic factors which obtain in simple anchorage. In simple anchorage the attachment to the anchor tooth may be of a pivotal nature, and as a result the term "pivotal anchorage"[2] has been suggested in place of simple anchorage. The one objection to the term "pivotal anchorage" is that it immediately confuses attachment with anchorage, which is a thing that should be considered separately. That is, terms should not be used synonymously, because anchorage and attachment are two different things. It is true that certain attachments will increase the anatomic resistance, but it is equally true that we must have an attachment to the malposed tooth, which I believe should not be confused with anchorage, and which should not be termed "secondary anchorage."

In order to obtain stationary anchorage, it is necessary that we consider more than the form of attachment.[2] To change an attachment from a pivotal to a nonpivotal one does not make stationary anchorage, for in addition to the

attachment there must be a rigid construction of the appliance. A great many unsatisfactory conditions have resulted in the practice of orthodontics through the belief that the attachment of the appliance was all that was necessary in order to secure stationary anchorage. Such attachment as shown in Fig. 2, which is of the nonpivotal variety, does not necessarily make stationary anchorage, and in the majority of cases is not stationary anchorage. It is only a nonpivotal form of attachment, for the construction of the appliance is not rigid enough to make stationary anchorage. The alignment wire, whether it is used as a labial or lingual appliance, is often of such small gauge and so elastic that the appliance will bend between the anchorage and the point of attachment to the malposed tooth, which in turn will allow the anchor tooth to tip, thereby

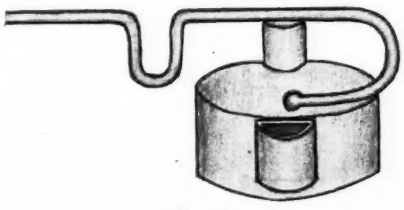

Fig. 2.
(After Pullen.)

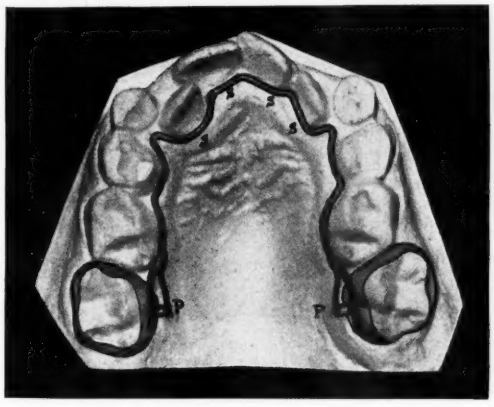

Fig. 3.
(After Pullen.)

Fig. 4.
(After Pullen.)

giving only a simple anchorage. Fig. 2 shows a nonpivotal form of attachment, but the second mechanical necessity for stationary anchorage is missing—the rigidity of construction.

In Fig. 3 perpendicular tubes are used on the lingual side of the molar bands, and if these tubes are half-round it will be a nonpivotal attachment in all directions, but it will not be a stationary anchorage. If sufficient force is exerted upon the malposed teeth to overcome the anatomic resistance offered by the anchor teeth, the anchor teeth will necessarily tip because no provision has been made to maintain a certain definite relation of the anterior portion of the alignment wire with the malposed teeth. In Fig. 4 is shown a similar attachment to the molar bands and bands have been placed on the malposed teeth with such attachment as to maintain the anterior portion of the lingual alignment

wire and a definite relation to the malposed teeth. However, this means of attachment to the anchor teeth and to the malposed teeth does not make stationary anchorage, unless the lingual alignment wire is sufficiently rigid and stiff to prevent any bending or spring between the anchor teeth and the malposed teeth. A large number of undesirable results have occurred in the treatment of malocclusion where men have tried to use stationary anchorage, and they have been led astray by believing that nonpivotal attachments were all that were necessary for the production of stationary anchorage. The second mechanical feature: rigidity of the appliance is necessary, which means the appliance must be sufficiently rigid that there will be no spring or bend between the anchor tooth and the point of attachment to the malposed teeth. Such appliances as shown in Fig. 5, where the labial alignment wire is a small gauge elastic wire, do not give stationary anchorage, because the wire is not rigid enough to prevent spring-

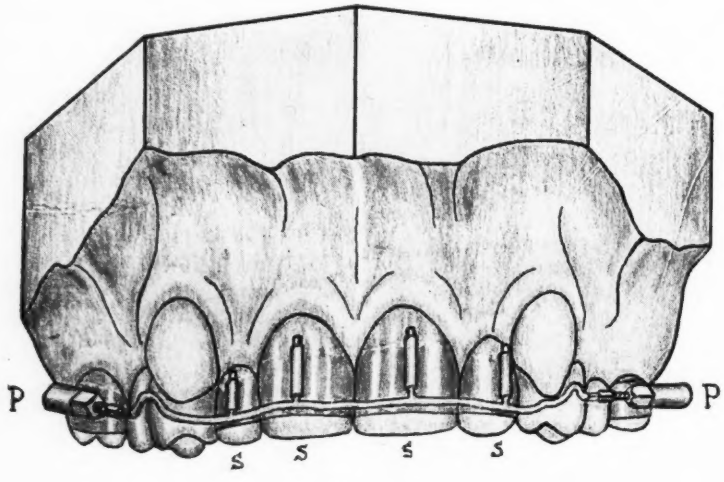

Fig. 5.
(After Pullen.)

ing or bending between the anchor teeth and the point of attachment to the malposed teeth. For that reason it becomes necessary to consider and make a distinction between anchorage and forms of attachment, because they are not the same thing, consequently a nonpivotal attachment upon an anchor tooth does not necessarily give a stationary anchorage. Stationary anchorage can only be obtained by the two mechanical features, attachment and rigidity of construction.

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A CONSIDERATION OF NORMAL ARCH FORM AND SOME OF THE METHODS OF DETERMINING IT*

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Part I

At the mere mention of normal occlusion there is produced in the mind of every student of anatomy a vivid picture of the relationship between the two arches which the term implies, as well as the general contour of the individual arches and the necessary interrelation of the opposing teeth. It would seem therefore it should not be difficult to state in exact terms just what constitutes normal arch form.

Simple as it may seem at the outset, the task of formulating such a definition is beset with numerous difficulties, a fact which is proved by the wide variance of opinion expressed by many studious observers. If we are to consider the subject from a practical standpoint, we are primarily interested in knowing what the relative shape and proportions of the normal dental arch should be in healthy, well-developed Americans, as they are the people with whom we are coming in daily contact, and it is such arches which we must attempt to reproduce in our restorative work.

This point should be carefully borne in mind, for if we follow the trend of thought of the anthropologist or the comparative anatomist we are apt to become confused in a discussion invoked by a consideration of arches found in ancient skulls, in variations of different so-called types, and, strange as it may seem, in races far removed from our field of activity.

Characteristic of the attitude of the anthropologist upon this subject I wish to quote from the writings of Dr. Ales Hrdlicka, Curator of the Division of Physical Anthropology, United States National Museum, Washington, D. C. In discussing the normal dental arch, he says:

"Under ordinary conditions of the skull and jaws, a normal dental arch is the arch of the normal set of teeth. Unless otherwise interfered with, the arch is what the teeth have made of it."

In speaking of what he terms "normal variations," he says:

"The Dolicho-uranic type of arch—a term given by Sir William Turner—is that type in which the relation of the external breadth of the arch to its length, in other words, the arch index, is less than 110. The meso-uranic type embraces the arches with indices between 110 and 115; and the brachy-uranic, those in which the index is above 115. The brachy-uranic arches are relatively broad and short normal arches, the meso-uranic may be termed medium, while the dolicho-uranic are relatively long and narrow. There exists then, quite an extent of variation in the relative dimensions alone of the normal arch; in fact,

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when we take enough cases, we find that the variation in the arch index among strictly normal arches will range from about 90 to 150. In other words, we find instances in which the external breadth is only about nine-tenths of the length of the arch, and others in which it will reach as much as fifteen-sixteenths. This great variety in normal arches may in fact be found in one and the same race, such as the whites or Indians."

In his conclusion he says:

"The main object of these remarks was to emphasize the fact that there is no such thing in existence, in any race that we know of, as one single normal dental arch; that in every race and even under most normal conditions, we find a variety of arches which must be considered as normal arches, and it will be the duty, it seems, of the dental surgeons of the future to pay close attention to these facts, because they can not but have a direct bearing on the intelligent treatment of patients."

If we are to accept the views of the anthropologist as applying literally to the people who come to us daily for help, most of us, if we are honest, must be overwhelmed with the responsibility of reproducing in this or that individual the type of arch to which he or she is entitled. The outlook would indeed be

Fig. 1.—The main types of the dental arch.

gloomy if he did not leave us one ray of hope, viz., he says at the outset, "Under ordinary conditions of the skull and jaws, a normal dental arch is the arch of the normal set of teeth. Unless otherwise interfered with the arch is what the teeth have made of it."

While this statement was not intended to give anything definite, it adds weight to evidence which will be presented later on and therefore should be borne in mind.

The late A. H. Thompson, in his book on *Comparative Dental Anatomy* gives us a result of his extensive observations, the following typical arch forms (Fig. 1): The square arch he says, "is found usually in persons of strong osseous organizations of Scotch or Irish descent, i.e, Gaelic extraction. The rounded square is the medium arch usually found in ordinary, well-developed Americans. The rounded arch is quite characteristic in some races, as the brachycephalic South Germans. The rounded V is the arch of beauty and that most admired in women of the Latin races."

Thompson's observations give us hope of arriving at something definite, for he says, "The rounded square or medium arch is usually found in the ordinary, well-developed Americans."

Bonwill, in his work on the articulation of the teeth examined as he says 4000 dentures in living persons and 6000 skulls and from these observations established as a standard an arch based on the equilateral triangle and conforming closely to the most perfect arches found. This arch (Fig. 2) is not exactly the form of any of the types illustrated by Thompson, but seems to be a combination of the rounded square and the rounded V, as might be expected, when we consider that Thompson is presenting what he considered distinct racial types and Bonwill, an ideal selected from the most perfect dentures found in his investigations.

While Bonwill's efforts were for the most part put forth in an effort to solve some of the mechanical problems of occlusion as they apply to prosthetic dentistry, he unquestionably realized the necessity for a definite idea of what constituted normal arch form as it applies to modern man.

If we attempt to assume that there is a more or less definite arch form which can be claimed as characteristic of the American people we are at once con-

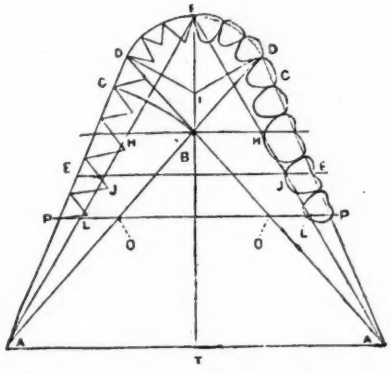

Fig. 2.—Bonwill's conception of the ideal dental arch.

fronted by the stumbling block so frequently occurring in our literature upon the subject; viz., "that the arches vary according to the type." If this is literally true we are still left floundering about in a maze so confusing that the average student is at a loss to know in which direction to turn, for we are without any very definite information as to how these various types are to be determined.

As an illustration of the truth of this statement, I wish to cite an experiment carried out by Percy Norman Williams.

Realizing that there were many conflicting opinions as to the shape of the arch, with a total absence of definite laws or standards, he endeavored to learn whether there was such a thing as uniformity of opinion. Securing a photograph of an individual who possessed natural normal occlusion (Fig. 3), he measured the teeth, noted their arrangement carefully, and secured duplicate sets in artificial teeth. He then wrote to ten well-known men in the profession, sending each one a photograph of the subject of the experiment, an upper model with the teeth removed, and one of the duplicate sets of artificial teeth. He requested these men to set these teeth up upon the model, shaping the arch as they thought it should be to harmonize with the face of the patient. He asked that

they disregard length of bite, compensating curve, etc., as all he wished was their idea of the form of the arch which would be correct for the type represented.

Several interesting and widely different opinions were expressed; some declining, saying it was impossible to determine the shape of an arch for a given type. Fig. 4 shows some arches received.

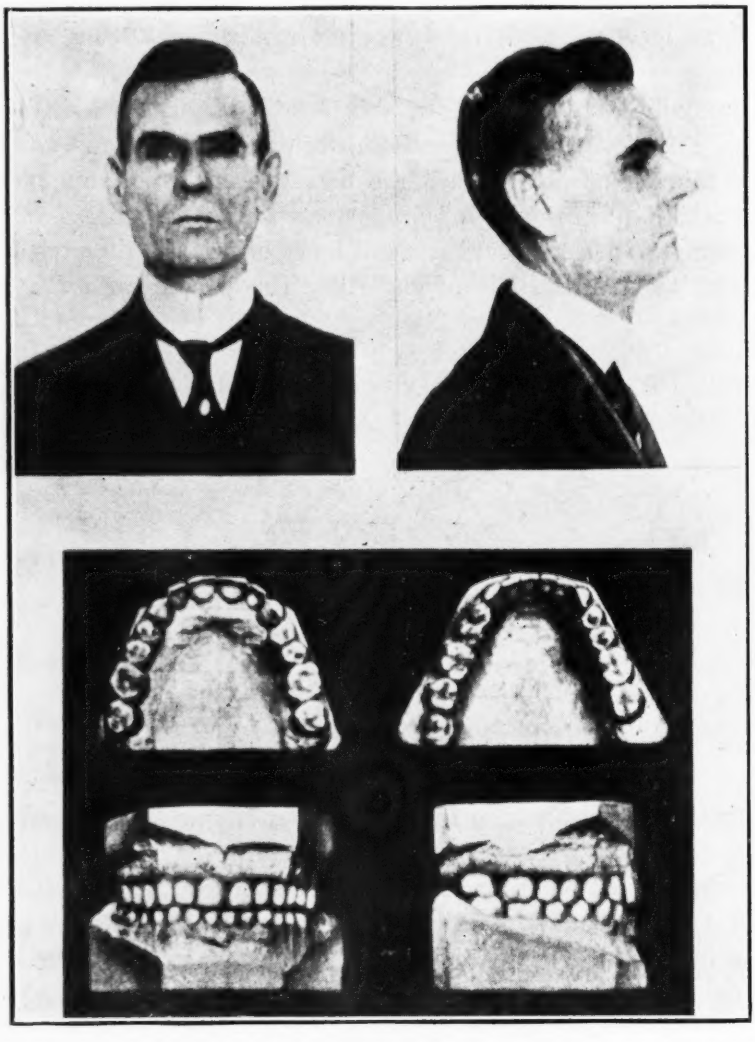

Fig. 3.—Showing the type submitted to various dental authorities, together with models of the subject's teeth.

It is obvious from the results obtained that the arches submitted were not constructed in accordance with any fixed law, but rather to conform with the individual ideas of the different experts. *That this lack of a definite idea of what really constitutes normal arch form is one of the most grievous shortcomings of dentistry should be apparent to every studious observer.* If we attempt to do for our patients restorative operations involving arch form upon the assumption that we are able to successfully do our work without some tangible law or plan, we certainly risk the accusation of either egotism or ignorance.

It might be done and no doubt has been done successfully by some few who were endowed with a deep understanding of art and anatomy, but how many of us can justly lay claim to such accomplishments?

Evidence to the contrary is to be found on every hand, if we but observe carefully the average person wearing a full upper and lower denture, or take note of mouths which have been submitted to the vagaries of hit or miss orthodontia. It would be difficult to say which branch represents the greater number of sins, but safe to say that numerous crimes have been and are being committed in the name of each. As an example of the lack of definite laws pertaining to the subject, I wish to quote from the well-known authority, Angle. In the seventh edition of his book he says:

"That we should have a line from which to note variations from the normal in the position of the teeth is important, but that its meaning is deeper and that it has a far greater significance to the student of orthodontia than above indi-

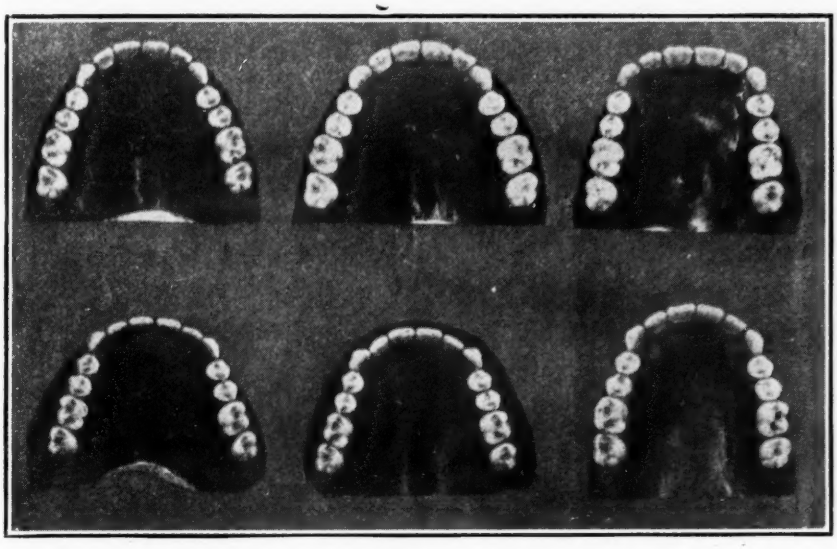

Fig. 4.—Showing teeth arranged by several dental authorities.

cated, the writer is fully convinced." In the sixth edition of this work he used the term "the line of occlusion" which he defined as being "the line of greatest normal occlusal contact." Yet after a much greater consideration of the subject he believes this definition though more nearly expressing the true condition than the terms previously employed is still inadequate and he would now define it as being "the line with which in form and position according to type the teeth must be in harmony if in normal occlusion.

"There can be then but one true line of occlusion and it must be the same as the architectural line on which the dental apparatus was constructed. This ideal line was intended to govern not only the length, breadth, and peculiar curve of the dental arches, but the size and pattern of each tooth, cusp, and inclined plane composing these arches. And more than this; that as the dental apparatus is only a part of the great structure, the human body, each part and organ of which was fashioned according to lines of design, it must have been intended that the line of occlusion should be in harmony in form and position with and in

proper relation to all other parts of the great structure according to the inherited type of the individual. Hence, its majesty, and acccording to our conception of it must be our ability to comprehend not only the arch requirements in each case we treat, but as well must it govern our conception of the requirements of the teeth in occlusion and the various operations in treatment. The line of occlusion then, is more than the tangible or material. It may be regarded as the basic ideal of the dental apparatus, the comprehension and appreciation of which will grow in proportion as our knowledge of the science of occlusion unfolds.

"This line describes more or less of a parabolic curve, and varies within the limits of the normal, according to the race, type, temperament, etc., of the individual. It is difficult to determine exactly what the form of this line should be in each given case."

So again we are left without anything tangible or definite as to the form of the normal arch for this distinguished writer's defining of the line of occlusion is too ethereal and hypothetical to be formulated into definite form.

More than one writer on dental anatomy has attempted to classify the teeth and dental arches according to so-called temperament and four typical basal temperaments are usually described. These are known as, "Bilious," "Nervous," "Sanguine," and "Lymphatic." Under these headings, dental arches are usually described in more or less definite terms, giving the form of the teeth, the character of curvature of the line of occlusion, length of overbite, etc.

If this classification could be accepted we might be in a position to arrive at something vaguely definite as to a classification of arch forms, but, unfortunately, it can not be accepted as it is founded upon assumptions which are not in accordance with real facts, therefore one formidable barrier which has ever stood in the way of coming to a definite conclusion as to what constitutes normal arch form should no longer be considered a barrier. I would not expect you to accept this statement if it were based solely upon my own observations, so I shall present evidence in proof which comes from sources which can not be lightly considered.

The eminent scholar, J. Leon Williams, in his book *A New Classification of Natural and Artificial Teeth,* has among other things discussed in a manner both thorough and accurate the question of temperamental forms of teeth. If we admit, as we must, that one of the chief corner stones of the theory that, "The arches vary according to type," was the acceptance of the idea that there are distinct temperamental and racial forms of teeth, and that nature always produces teeth in harmony with face and feature, we must realize that if this important part of the foundation be suddenly removed the whole superstructure must painfully sag or collapse.

Before proceeding with the discussion of the temperamental theory, I wish to again call your attention to the definition of normal arch form given by the anthropologist, for while it is not definite, it should be borne in mind as it has an important bearing upon the conclusions which I shall ask you to consider later. "Under ordinary conditions of the skull and jaws, a normal dental arch is the arch of the normal set of teeth. Unless otherwise interfered with, the arch is what the teeth have made it."

Part II

In his discussion of the "Temperamental Theory" Williams says in part:

"You will I think be able to see more clearly the relation and significance of the facts presented if I state specifically the main objects I have in view in this paper. I shall attempt to destroy all belief in temperamental forms of teeth, for I regard this as one of the most fundamental errors in the present system. I shall try to show that while there are slight variations in the teeth of different peoples, there is no such thing as racial types of teeth. I hope to convince you that the oft-repeated statement that Nature always produces teeth in harmony with face and feature is a mistake due to lack of careful observation.

"One writer on the subject of temperament says: 'In these temperamental differences, no single sign is more significant than is to be found in the physical characteristics of the teeth—their size, shape, color, density and alignment be-

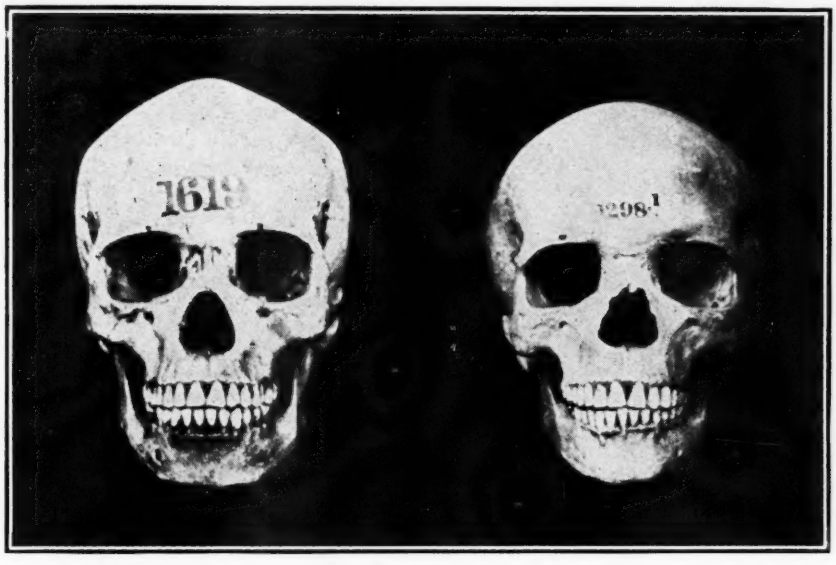

Fig. 5.—Two skulls of unlike form with teeth identical in type and size. No relation between form or size of skull and the form or size of teeth.

ing as much an index as is the distinctive complexion, the color of the eyes, hair, etc.' A little farther down the page it is said: 'The law of harmony thus found in nature between the teeth and other physical characteristics requires,' etc., etc., and once more: 'The careful observation and recording of these co-relations would go far toward making prosthetic dentistry an exact science.' Here we have three variations of an assumption that Nature always produces teeth that in form and size are in perfect harmony with the face and the individual features of the face. We often meet this assumption in our textbooks and in magazine articles. On what is it founded?

"Let me put a few of the facts bearing on this question before you. Here is a photograph of two skulls (Fig. 5). You will observe that the difference in general contour is very marked. But the teeth you see, are identical in size and type. If either set is in perfect harmony with size and contour of face, the other set can not possibly be so.

"Here are two more (Fig. 6), a very wide and a very narrow skull. Think

what a striking difference there must have been in the facial contour of the two individuals those skulls represent. But you see the widest and shortest teeth are in the long narrow skull. And here (lower pictures in illustration) are two more from the Andaman Island, both skulls from the same race. Here again the smaller skull has the larger teeth. Note also that they are not of a different type.

"Here we have four skulls (Fig. 7) so nearly alike in size and contour that a single set of teeth would be just as suitable for one as for another of them, but look at the difference in the natural teeth. At least three of those must be

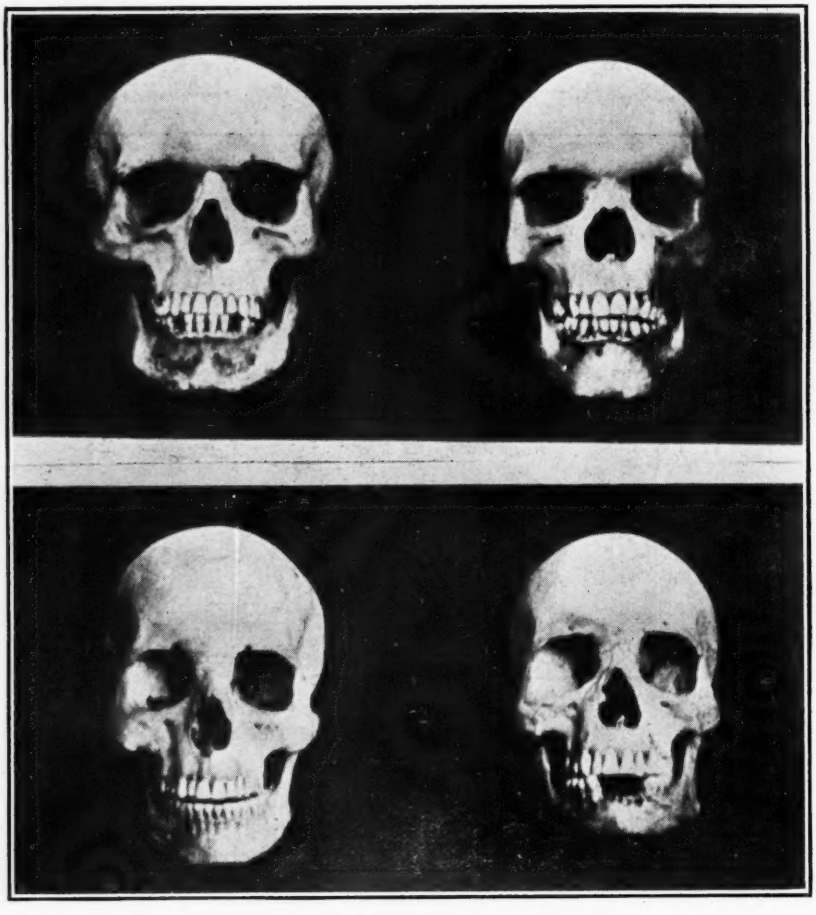

Fig. 6.—(Upper.) The widest and shortest teeth are in the narrow skull. (Lower.) Two skulls from the Adaman Islands. The smaller skull has the larger teeth and of a different type, than the other.

examples of disharmony. A glance at the teeth is sufficient to demonstrate the mistakes of nature. I could take up the whole evening in showing you examples of this sort, but as further proof on this point will appear incidentally when I am considering other phases of my subject, I will not dwell longer on it now. Unless some one can advance good and satisfactory reasons for believing that Nature is more solicitous about the harmonious relations of our dental organs with other features than she is about those of our eyes, ears or nose, we will conclude that the subject is always open to the intelligent criticism of an artist in teeth.

"Who has ever got together even a dozen peoples of one temperament, selecting them by their alleged physical temperamental peculiarities without looking at their teeth and then examine the teeth to see if they were all alike or of one type? If that simple experiment had ever been made it would have been seen that this pretentious structure (the temperamental theory) is as frail as a house of cards and as empty as a soap bubble.

"And now let me lay before you the final and crushing proofs of the utter futility and fallacy of this theory.

"What is the origin of those physical characteristics that are called temperamental?" You have all seen pictures from life which represented the three

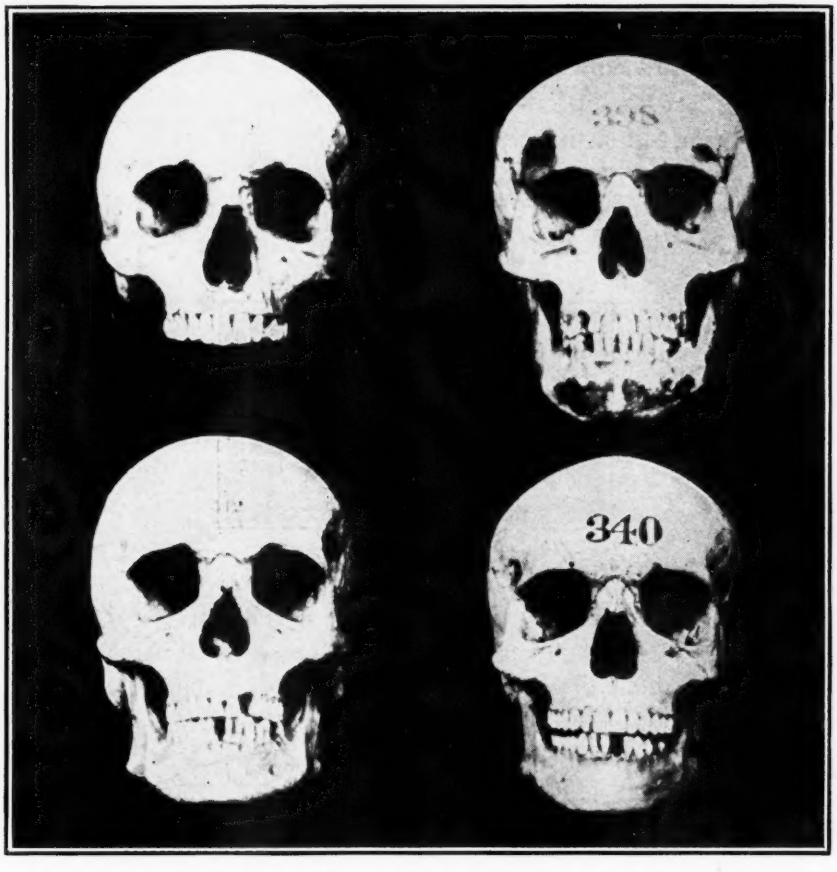

Fig. 7.—Four skulls of same type, but with very dissimilar teeth.

great races from which it is believed all the modern peoples of the earth have arisen; viz., the black race, the yellow or Mongolian, and the Caucasian race, and you are all familiar with the three distinct types of skulls, long, broad, and medium, which are considered most characteristic of these distinct races.

"Away back in neolithic, or even in the paleolithic times, there were two races in Europe—the long headed or dolichocephalic type, and the broad or round heads, the brachycephalic type.

"The Caucasian race is, possibly, a later evolutionary development. Broadly speaking, the fair races, and, to a large extent, the yellow races, are found in Northern and Central Europe and Asia, while the darker races occupy the equa-

torial and Southern regions. From the mingling of those light and dark races, the working of the principle of variation, and the modifying effects of climate and general environment, there has arisen all the racial or temperamental characters that the widely varied inhabitants of the earth exhibit. There are many theories and there is much speculation about these ancient races, but all theories and all known facts are in agreement on the point of the meeting and mixing of dolichocephalic and brachycephalic races in Europe in prehistoric times.

"The mixed temperaments are simply the result of mingling of the blood of different races, somewhat modified, in the event of migration by changed environment. If, therefore, there is such a thing as a sanguine type of tooth, or a bilious type of tooth, they must have originated in the sanguine and bilious races. If there are special characteristic temperamental forms of teeth, there must have been racial forms from which they were derived. There is no possibility of evading the logic of that conclusion. And I think it has always been assumed by our profession that there are racial forms of teeth. I think you will find many references in our literature to this supposed fact. Now a racial form of tooth must mean a distinctive form peculiar to a race. But if I am able to show you that there is no such thing as a racial form of tooth, if I can prove

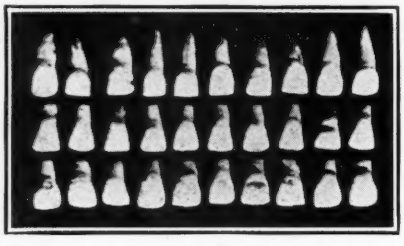

Fig. 8.—Three classes of centrals. Class 1, upper row; class 2, middle row; class 3, lower row.

beyond all possibility of a doubt that there are certain primary forms of teeth which are in their general type characteristics common to all races light and dark, ancient and modern, and savage and civilized, then I submit that even the unreasonable minority will have to agree that all belief in a temperamental type of tooth must go.

"There are certain differences as to size and small differences in proportion of width to length in teeth of the same general type in different races. But as to essential differences in type there are none.

"Let us now examine in detail the proofs of the statements that Nature produces three typal forms of teeth in all races and modeled all teeth upon these three. You have on the screen a photograph (Fig. 8) representing a small but representative selection of the three primary forms or types of human teeth. In all reference to them they will be designated as Class I, II, and III. Class I is characterized by the parallel or nearly parallel lines which represent the proximal surfaces of these teeth for half or more than half of their length from their incisal edge. In Class II these lines converge so markedly that they would meet in most instances at a point near the end of the root. These converging lines are sometimes nearly straight, but usually there is a very slight convexity of the mesio-proximal surface and a slight concavity of the distal surface. Class III,

which I regard as the most beautiful form of human teeth, and which has rarely if ever before been used as a model for artificial teeth, is characterized by a delicate double curved line on its disto-proximal surface and sometimes, though less frequently, on the mesial surface. All of the surfaces and angles of teeth of this class are more rounded and graceful than in either of the other two classes. The specimens shown in this photograph represent the most severe or typal shapes of what I call the primitive forms of human teeth. My reason for the use of the word 'Primitive' will appear later. All of the other teeth in any given set partake of the features of the central incisors, but to a much less marked degree. But in this respect the natural teeth of a given set are not always in harmony. The crossing of races or some other cause often disturbs the perfect harmony of line of the different teeth in a set, and you may sometimes find centrals of one class and laterals and canines of another, but usually the harmony is more or less perfectly preserved. In designing artificial teeth we can, of course, *always* maintain a proper harmony throughout and thus improve on Nature. The succeeding photographs will show you laterals (Fig. 9) and canines arranged in the order of the three classes. As I have intimated, the class characteristics are not so marked in these teeth as in the centrals, but you will have

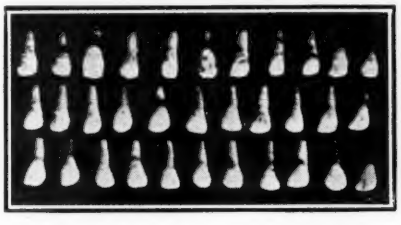

Fig. 9.—Three classes of laterals arranged like centrals in Fig. 8.

no difficulty in seeing in any of the groups something of the special features of each type. In this photograph you see the effects of crossing the types. There is more or less blending of the primitive forms, although in nearly every instance the dominance of one type or another can be perceived. Probably the majority of teeth in all mixed races are of this character.

"We will now pass to an examination of the teeth of some of the more important civilized and savage races of ancient and modern times, in which I shall show you that the three types or classes of teeth I have illustrated and described are to be seen in the skulls of all these otherwise widely divergent peoples. In this first exhibit the skulls will all be shown in groups of three, thus presenting in one view the three primitive forms of teeth in each race. We will begin with three skulls from a savage race of today—the Sandwich Islanders (Fig. 10). The shape of the skulls differ markedly, but this difference in skull shape has no necessary relation to the different forms of teeth. We have here the three primary forms of human teeth very clearly shown. We have square teeth with parallel sides in skull No. 1, the pyramidal-shaped tooth with its converging lines in No. 2, and an ideal specimen of Class III, with its beautiful curves in skull No. 3.

"As you would expect, not all the teeth in the different groups of skulls which I shall exhibit are such perfect examples of the severer forms of the three classes.

Probably perfect examples could always be found if one had a sufficiently large number of skulls at command. The surprising thing is that even in a small collection of skulls, often less than a dozen, I have always been able to find fairly good representatives of the three classes, but I believe that the more severe typal forms are more frequently found in those races in which there has been the least crossing.

"A group from the Fiji Islands (lower portion of Fig. 10). Please observe that while the teeth are not all good examples of the primary forms of their

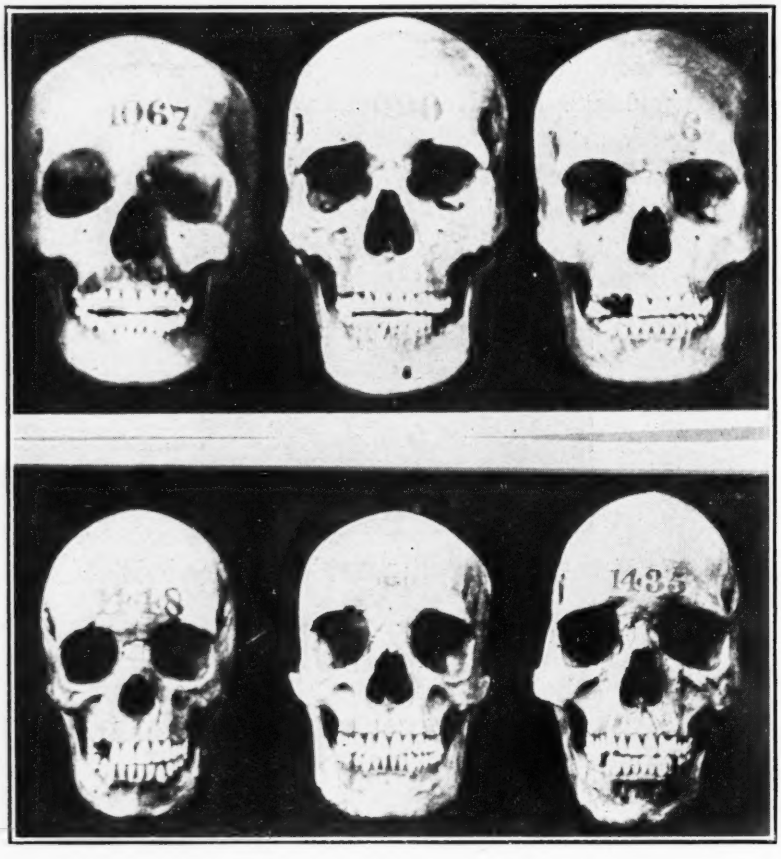

Fig. 10.

class, yet the variation in form is so great as to completely upset the theory of a racial type of tooth.

"The next two and three groups of skulls are in some ways the most interesting in the entire collection shown you tonight. The natives of Australia (upper part of Fig. 11), Tasmania (center of Fig. 11) and New South Wales represent the lowest type of human being of modern times. The skulls of these savages have many points of resemblance to the Anthropoid Apes. Here, if anywhere, you might expect to find a racial form of tooth. But just observe the difference in the shape of these skulls and teeth. With the exception of the teeth of the ancient Egyptians, these low Australian savages exhibit the characteristics of the three primitive forms or types of teeth more clearly than

any other in the groups I have shown. No. 3 is, I believe, regarded as one of the greatest anatomical treasures of the Museum of the Royal College of Surgeons. It probably shows a more intimate relationship with the Anthropoid Apes than any other modern skull. It was received from Australia just as I was finishing this work of investigation, and was photographed for the first time for me.

"The last group in this series that I shall show you (lower row of Fig 11) is

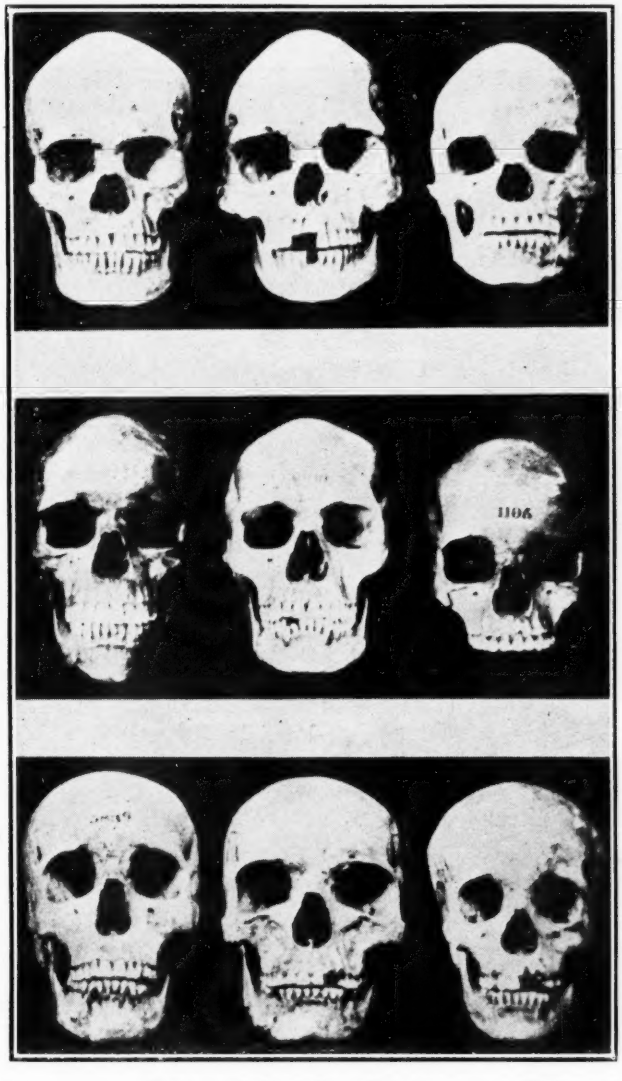

Fig. 11.—Upper group: Natives of Australia. Center group: Natives of Tasmania. Lower group: Ancient Egyptians.

from that very interesting ancient race, the Egyptians of the third and fourth dynasties, the period dating more than two thousand years before Moses led the children of Israel out of Egypt. We are back in the bronze age at the dawn of what we call civilization, the time of the Troy, of the Iliad, and before the Great Pyramid was built. It was a piece of great good fortune to have found three such perfect skulls from this far distant era, showing so perfectly the three primary types of teeth. They are each ideal specimens of their class. The teeth in skull No. 1

answer perfectly to the description given in our textbooks of the sanguine types of tooth, but I believe all authorities are agreed that those ancient Egyptians did not have light hair or blue eyes or a ruddy light skin. There is evidently a mistake somewhere, perhaps it is a fault of the Egyptians. But the forms of teeth shown in the other two skulls have never been observed by any advocate of the temperamental theory of classification. New temperaments will have to be invented for them.

"Suppose the teeth in all three of these skulls had been, as might easily have

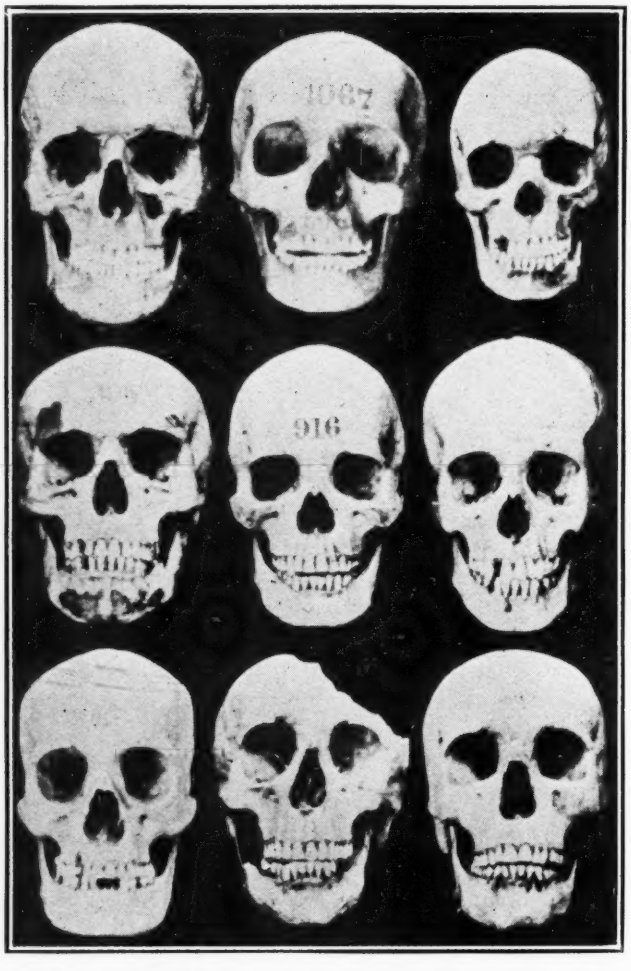

Fig. 12.—Nine skulls of different races and unlike size and contour, all with teeth of class 1. The form and size of the teeth bear no relation to the form or size of the skull. Nationalities from left to right are: Spanish, Sandwich Islanders, New Hebridean, German, Javanese, Hindoo, Figi Islander, Itobian, Ancient Egyptian.

happened, of Type I, a strong tooth full of character. Would it not have been said that here was a typical racial tooth form of the ancient Egyptians? This mistake concerning racial types of teeth has grown out of insufficient critical observation.

(Fig. 12.) "During life the individuals which these skulls represent must have presented a great variety of facial contours, but observe how many of the central incisors in these varying skulls are alike or nearly so. Look at the upper

row of skulls. The teeth are identical in type and nearly so in size. But what a contrast in the skulls, especially in 1448 and 398, and again you see the smaller skull has slightly larger teeth.

"Again I say the proof that Nature produces no perfect harmonies of relationship in the different parts of organisms is to be seen on every hand. It is before our eyes all the time.

"More than that I will say that any one who will take the trouble to examine and compare forty or fifty skulls from almost any race, will be forced to the conclusion that if he wishes to follow Nature blindly in the matter of adapting teeth to facial contour, he has a fairly wide range of choice in making his selection. It would probably express an important truth to say that Nature seems to be always striving to reach or realize harmony, but rarely achieving a perfect success and sometimes going very wide of the mark. *The great variety of inconsistencies in Nature emphasizes in a most striking manner the paramount importance of finding some fixed principle of harmony between tooth form and facial contour. Art supplies us with that which Nature has failed to give us. What we have to do is to study closely the majority of instances in which an approximation to harmony is seen, and from the knowledge thus gained to deduce the general principles on which the highest possible degree may be based.*

"The one important fact we have established up to this point is that there are three types of teeth common to all races.

"I have no need to labor this point of identity of tooth form in different races or to press for conclusions in the least, beyond what the facts will fully warrant, but I submit that I have destroyed the last vestige of a belief in a racial type of tooth. And along with the passing of that belief there must disappear also the theory of a temperamental type of tooth. *My summary of the whole matter is this: That as a working theory it has always been so vague in statement and indeterminate in application that it has never taken any serious hold upon dentists* and is practically a dead letter with more than nine-tenths of the profession, that to teach a theory which no one really practices or understands is immoral because it leads directly to a disbelief in any scientific basis for prosthetic dentistry; that if there had ever been any real desire to undertake a practical application of the theory, it would not have been possible to do so, and lastly that the theory has absolutely no foundation in scientific fact because *it is fully incontrovertibly demonstrated that any given forms of teeth are not peculiar to any race, neither do they bear any necessary relation to the shapes or sizes of skulls."*

Part III

In this discussion of arch form, it should be borne in mind that we are considering arch form alone and not the relationship which the arches bear to the rest of the skull. This is important, for unless this point is clearly emphasized, our vision is apt to become clouded and confused by instances of prognathous arches which at first sight might be construed as being architecturally entirely different from what we consider as being normal. A favorite example of such an arch quite popular with the exponents of the "variations according to type" theory is the Fan Tribe of West Africa (Fig. 13). Even if such arches should prove to be different, they should not materially affect our conclusion, for probably

none of us will ever be called upon to do restorative work for members of the Fan Tribe of West Africa, or will we care to reproduce in our patients such an occlusion. Even those who still cling to the theory of type and temperament must admit that out interest is centered upon arch form as we see it in normal, well-developed Americans. Before going into details as to the architecture of such arches it will be interesting to note the opinions of some well-known authorities who apparently are reasonably in agreement upon certain phases of arch form which are of interest to us.

(Broomell) "The teeth are arranged in the jaws in the form of two parabolic curves, the superior arch describing the segment of a larger circle than the inferior, as a result of which the upper teeth slightly overhang the lower."

(Gysi) "The arches have the form of a parabolic curve, the incisors and canines of both arches form part of the arc of a circle."

(Talbot) "In the skull, in taking the two cuspids for the starting point the arc of a circle is found.

(Black) "The upper teeth are arranged in the form of a semi-ellipse, the

Fig. 13.—Fan Tribe, West Africa.

long axis passing between the central incisors; occasionally the molars and bicuspids form a straight line instead of a curve and frequently the third molars are a little outside the line of the ellipse. * * * * * The incisors are arranged with their cutting edges forming a continuous curved line from cuspid to cuspid and this line is continued over the cusps of the cuspids and buccal cusps of the bicuspids and molars to the distal surfaces of the third molars. * * * * * The lower teeth are arranged similarly, but on a slightly smaller curve, so that the line of the ellipse, which falls on the buccal cusps of the upper bicuspids and molars, will fall upon the buccal surfaces near the gum of the lower teeth.

(Tomes) "The teeth of the upper jaw are arranged along a curve of larger dimensions than those of the lower."

(Kingsley) "The normal type of dental arch I conceive to be a regular line. The arch may be wider or narrower, varying somewhat in individuals or races, but the line will be an easy graceful curve without a break or tendency to form an angle."

It seems to be quite generally conceded that the six anterior teeth describe the

arc of a circle and that the general form of the normal arch is parabolic in character. If we accept this our next concern would be to arrive at some definite idea of the size of the circle from which the arc is taken and the relationship which the arc bears to the width of the arch, its length, etc.

Of the more recent investigators of this subject, the work of Percy Norman Williams is of great interest and importance. In speaking upon the subject of determining the normal arch and relative proportions of such an arch he says:

"In an attempt to determine upon what parts of the arch I should make measurements, it occurred to me that it would be necessary to locate the center of the circle described by the front teeth. I took a photograph of a normal arch, located the median line and moved the compass back and forth on this line until the other point would fall on the six anterior teeth and invariably the center occupied a point midway between the molars. Acting for the time being on the assumption that the center of the entire arch might be at this point, I decided to take one measurement between the first molars, which I shall call *A* (Fig. 14). I also saw that the size of the circle in front was dependent upon the distance between the canines, that is, if the front teeth occupied the arc of a small circle, the cuspids would be nearer together than they would if the teeth were arranged in the arc of a large circle. I decided the distance between the points of the cuspids should be my next measurement, which I shall call *B*. These two measurements would indicate the width of the arch. The only measurement now necessary was to determine the length or depth from front to back along the median line. It is obvious that in a live subject, or on a model, it would be impossible to locate a fixed point at the back of the mouth, so this was overcome by measuring from the buccal groove of the first molar to the median line. This measurement I shall call *B*. This line *B*, being the hypotenuse of a right angle triangle, answers every purpose for determining the depth of the arch, as once this line is known the length of the median line is easily determined.

"The first set of measurements was taken from arches of five subjects, in all of whom the teeth were in normal occlusion. I might mention the fact that at the beginning of this work it was my intention to measure jaws in normal occlusions, excluding all others. I soon saw, however, that I was excluding some valuable material which might prove to be more interesting than cases of normal occlusions, all of which were natural arches, never having undergone orthodontic treatment. I was quite startled to find that the ratio of these three lines which I have already mentioned was practically uniform throughout five cases. They were as follows:

A	B	C
56	40	36
60	42	38
59	41	37
56	40	35
54	38	34

"Taking the average of these measurements and reducing them to the lowest ratio without fractions, we have

$$\frac{A}{14} \quad \frac{B}{10} \quad \frac{C}{9}$$ (See Fig. 14)

"As all of these first cases were beautiful examples of occlusion, I concluded there must be something significant in these strikingly similar measurements, and at once determined to see if Nature were playing a trick or if this were her method of constructing natural dentures. I thought at the time that living subjects were necessary, so I secured access to some manufacturing establishments and began to systematically measure arches of employees. My first group consisting of 50 individuals is shown here with the average ratio (Fig. 15). I selected only those which were free from marked irregularity. Little attention was paid to any arches that were out of alignment or showed arrested development. I soon learned that the percentage of arches suitable for measuring would be very low, so I began to look elsewhere. I visited the Museum of Natural History in New York City, and made measurements of skulls of about 50 of the native North American Indians, many of which were over five hundred years old. While many teeth were missing in most of the skulls, fortunately I found quite a number with the molars and cuspids present. Because of the loss of incisors

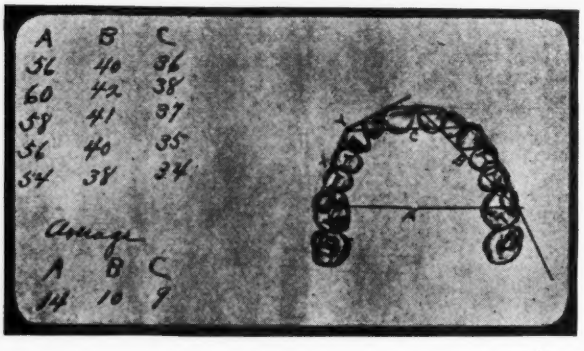

Fig. 14.

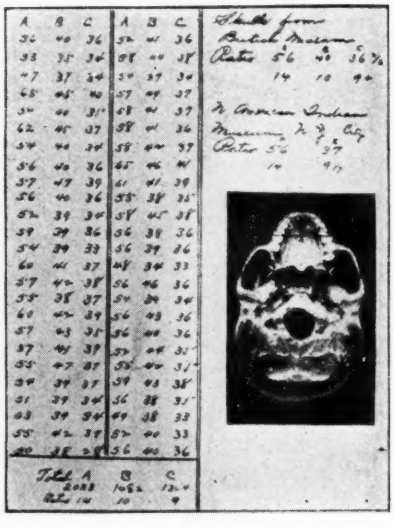

Fig. 15.

I am able to show only measurements *A* and *C*. You will be interested to know that while making these measurements at the Museum, I was very fortunate in meeting Clark Wissler, Director of the Department of Anthropology. I laid what material I had before him and expressed the opinion that there was not the variability of shapes in the arches that was generally believed. I wish to quote his exact words as he replied for I was so impressed that I wrote them down at the time. 'There is no anatomical part in animals so uniform as dentition. Even between primitives and man there is a striking likeness in the shape of the jaw. Teeth make the arch, the species variability is so small in the ratio type that it requires careful measuring to detect the difference in shape.' "

Another investigator whose observations coincide with the findings of Williams, says:

"In an article published in the *Dental Cosmos* for November, 1917, I derived the relationship which exists between the dimensions of teeth and the di-

mensions of the arch. From the data, for which I am greatly indebted to Dr. Percy N. Williams, of New York, I showed that in the upper arch there are five points which lie on the circumference of a circle, the center of which is midway between the two first molars on a line joining their buccal grooves. These five points are the buccal grooves of the two first molars, the tips of the two canines and the point between the central incisors on the median line. This relation is so rigid in a normally developed arch that the values which I calculated corresponded within one or two millimeters with Williams' measurements. Fifty-four arches were taken at random, and in about 30 per cent, the calculated and measured values differed by only a fraction of a millimeter. In about 40 per cent the variations were two millimeters or less and in the remaining 30 per cent, the differences in the majority of cases were not higher than four millimeters in the width of the arch. These figures are very significant for even these small differences are reduced when the errors in measurements are accounted for."

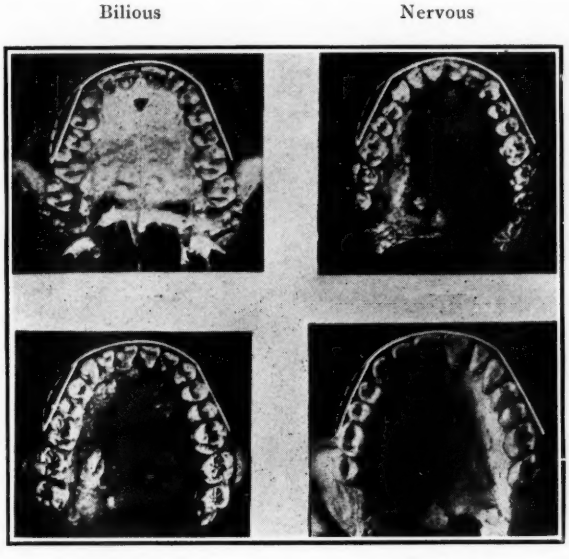

Fig. 16.—Typical arch outlines for the four basal temperaments. (From Turner's Prosthetic Dentistry.)

The same author further states: "If we consider that the ratio and temperamental differences find their expression in the form and the relative sizes in the teeth, we can readily understand how the outline of the arch is influenced by such differences. The position of the canine determines whether an arch is considered relatively wide or narrow and the location of the cuspid is dependent upon the relative mesio-distal dimensions of the crowns of the anterior and posterior teeth. If the anterior teeth are too large in comparison with the posteriors, the cuspids are pushed farther away from the median line along the anterior curve, and the arch will appear to be wide. If, on the other hand, the anteriors are too narrow the arch will have a narrow appearance.

"I also admit that a certain degree of curvature may seem to be present in the bicuspid region and this can be more clearly seen on photographic plates. Here I wish to emphasize that the buccal cusps and not the buccal surfaces of the posterior teeth are placed along a straight line. A line touching the buccal sur-

faces of the posterior teeth is a graceful curve which may be pronounced especially in the bicuspid region. The fact that in a normal arch the six anterior teeth lie along the circumference of a circle whose diameter is the distance between the buccal grooves of the first molars and that the buccal cusps of the anterior teeth are on a straight line will be true for all arches regardless of type.

"All this is clearly shown in the illustration (Fig. 16) which represents typical arch outlines for the so-called four basal temperaments. It may be noted that the arches of the bilious and nervous temperaments are unsymmetrical, that the left side is approximately normal in each case. The sanguine and lymphatic arches are very nearly normal. The diagrammatic outlines are drawn slightly larger than the proper size, for the sake of clearness. The writer selected these illustrations from a standard textbook. They were not originally intended to demonstrate these points, and it is hoped that the reader will be the more forcibly impressed with the facts."

These two investigators seem to be agreed upon the question of what constitutes normal arch form and the fact that they have based their conclusions upon the results of systematically acquired information makes them worthy of serious consideration. It is also of interest to note that in its main features such an arch will comply with the requirements laid down by the Anthropologist who says that, "under ordinary conditions of the skull and jaws, a normal dental arch is the arch of the normal set of teeth. Unless otherwise interfered with, the arch is what the teeth have made of it." It is quite easy to understand how arches entirely fulfilling the requirements laid down by Williams and Sved might differ somewhat in appearance, for no two arches could be exactly alike unless the teeth were exactly alike.

This is an important point to consider for usually when any definite plan of arch form is discussed, the average dentist immediately has a mental vision of a stereotyped form of arch without any latitude for variability. This, however, would not be true of arches designed according to the before-mentioned requirements, for if the anterior teeth occur large in proportion to the posteriors, the cuspids would be arranged farther away from the median line along the anterior curve and the arch would have a broad appearance, while if these teeth are narrow in comparison with the posterior the arch would have a narrower appearance.

As stated before, the six anterior teeth lie on the arc of a circle, the center of which lies midway between the buccal grooves of the first permanent molars. As a matter of fact this arc does not include the entire tooth substance of the six anteriors, but extends from the point of the cuspids on one side to the point of the cuspid on the other side. The mesial side of the cuspid takes the curve of the anterior teeth, while the distal portion of the cuspid takes the line of the bicuspids. In relation to the cusps of the bicuspids, this line would be a straight line which would extend from the point of the cuspids to the crest of the mesio-buccal cusp of the first molar, where the line again bends to pass in a straight line over the disto-buccal cusp of the first molar and buccal cusps of the second molar. While it might appear that the arch line from the anterior curve forms two sharp angles, one at the cuspid and another at the buccal cusps of the first molar, this is not really the case, for when the curvature of the buccal surface

of the cuspid and the bell or contour of the cusps of the bicuspids and molars are taken into consideration it will be seen that a gentle curve is described.

It is interesting to note that Gysi in considering the problems of articulation has described arch outlines which conform very closely to those described by Williams and Sved (Fig. 17). While he does not state definitely what the width should be between the molars in relation to the arc of the anterior curve, he does make the following statements: "The arches have the form of a parabolic curve. The incisors and canines of both arches form part of the arc of a circle. * * * * *

"The distal cutting edges of the canines of both upper and lower arches should point in the direction of the molars, the necks of these teeth only being prominent, allowing the bicuspids to be placed so that they are only slightly visible from the front.

"Two straight lines touching the buccal surfaces of the bicuspids should

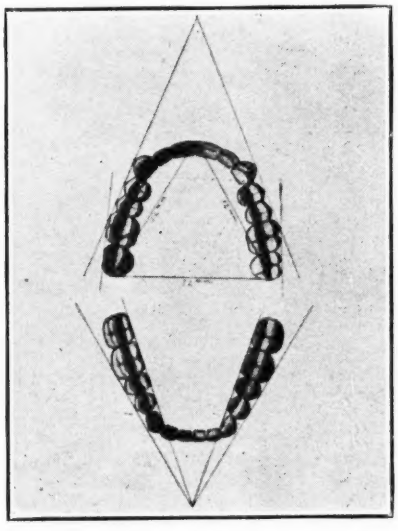

Fig. 17.

touch the mesial corner of the first molars and the distal half of the canines. The intersecting point of these lines should be at the same distance from the incisors as the incisors are from a line drawn across the base of the arch." (Gysi—the Problem of Articulation—Chapter 6, Cosmos, lii, No. 3.)

These arches differ rather conspicuously from the ideal arch described by Bonwill, in that the anterior teeth lie upon a smaller circle and there is less width between the molars. It will be recalled that six anterior teeth in such an arch lie on the arc of a circle, the radius of which is determined by the combined widths of the central, lateral and cuspid. The arch line after leaving the circle formed by the anterior teeth passes over the buccal cusps of the bicuspids and molars. These teeth, therefore, would be in a straight line which is extended backward from the cuspid in accordance with a geometric plan. The geometric plan upon which the Bonwill arch is established is shown in Figs. 18 and 19. This principle which was originally intended as a guide in setting up artificial teeth has been adapted to orthodontia by C. A. Hawley.

Some very interesting work along the line of arch predetermination has been done by W. H. Gilpatric whose idea of the normal arch differs somewhat from any of those thus far presented. Upon comparing his conception of it with those I have already described it will be found to be a compromise in width between the arches designed by Williams and Sved and the Bonwill arch. Like the other arches the anterior teeth lie upon the arc of a circle and the arches are parabolic in form. The diagrammatic outline of such an arch is shown in Fig. 20. It is interesting to note the process by which Gilpatric arrived at his conclusion. Like Williams and Sved he was convinced that the form of the arch

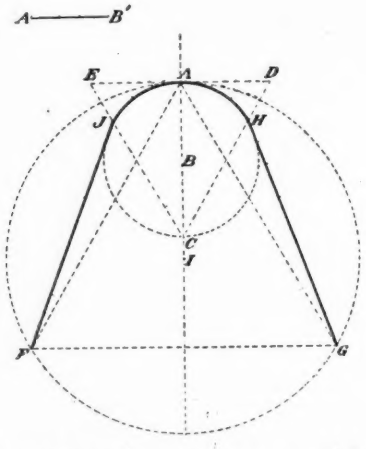

Fig. 18.—Hawley's adaptation to orthodontia of the Bonwill principle.

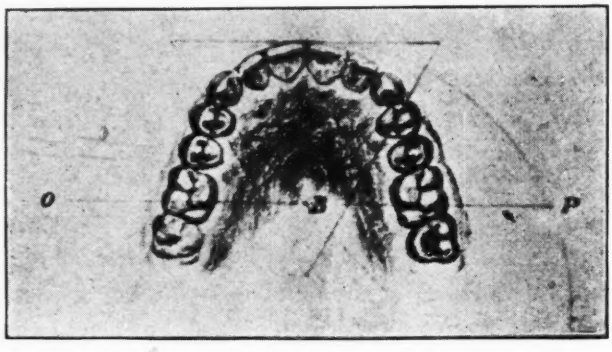

Fig. 19.—An ideal arch constructed according to the Hawley plan.

must depend upon the amount of the tooth substance within it. With this idea in mind, he selected trubyte teeth whose tooth substance was equivalent to that found in natural arches of various sizes. These he set up in an anatomic articulator and arranged them according to his conception of what constitutes arch form. He then subjected these teeth to all the various movements of occlusion and modified the shape of the arches until all such movements were possible. After the work on each arch containing a definite amount of tooth substance was completed, he submitted the result to Dr. Beckford, Professor of Prosthetic Dentistry at the Harvard Dental School, who approved of his findings. Notwithstanding the fact that his conception of the arch does not coincide with that

of Williams and Sved, Gysi, Bonwill or Hawley, the work he has done has been so thoroughly done that it is deserving of commendation and serious consideration. He has analyzed arches which vary in tooth substance from 78 mm. to 101 mm. (for the upper arch measuring from buccal groove to buccal groove of the first molars, and the corresponding tooth substance for the lower arches which he found varied from 8 to 12 mm. with the uppers). From these surveys he has produced a set of charts showing the survey of all of these arches. An interesting article outlining some of his work along this line was recently published in this JOURNAL.

A civil engineer interested in some of the problems of orthodontia once made the statement that orthodontia must outgrow the use of indeterminate appliances, and borrow from engineering the practice of laying out on paper what is proposed to be done before trying to do it. He supplemented this remark by saying that until such a plan was adopted orthodontic treatment would continue to be purely experimental—an art based on experience.

Whenever any attempt has been made to bring analytical mechanics and mathematics into orthodontic treatment, the objection has often been raised that these exact sciences are contraindicated, as they do not aid in the interpretation of biologic phenomena.

Such an objection, however, should hardly be taken too literally, for notwithstanding the fact that there are biologic factors involved in the movement of teeth which are not governed by mathematics or mechanics, we nevertheless realize that mechanical forces applied scientifically and correctly (which is possible in the hands of one who understands them) will not act conversely to biologic laws, and indeed, if so applied, will make more easy the solution of these problems.

Whenever orthodontic treatment is contemplated for a given case, the operator usually gives careful thought to the character of the appliances which are to move the teeth, and usually has in mind a more or less accurate idea of the extent of tooth movement required. As it is his wish to place every tooth in its correct relationship with the line of occlusion, would it not be logical to determine before tooth movement is begun what the line of occlusion should be? Certainly if every operator would do this, cases could be handled more intelligently and the various teeth moved into whatever positions were necessary, with a minimum loss of time or false movements.

If such a plan were universally followed, it would unquestionably have a tendency to shorten the active period of treatment, which would mean much to the comfort and welfare of our patients, because work carefully planned and systematically carried out would of necessity require less time than work accomplished under any other plan.

THE HAWLEY METHOD OF ARCH PREDETERMINATION

Unquestionably, Hawley appreciated these points and realized their necessity, and to him is due the credit of making the first attempt at predetermining arch form. As almost everyone is familiar with this method it will not be described in detail at this time.

The Hawley method has been the subject of considerable criticism, not only from dental engineers, but orthodontists as well, who have objected to it on various grounds. Notwithstanding this criticism, I feel that great credit is due Hawley for the spirit in which he introduced this method, and I venture the opinion that had it been universally adopted at the time it was introduced, more satisfactory results would have been accomplished by orthodontists generally than have resulted by every operator creating arch form in accordance with his own ideas of what it should be. Hawley did not make extravagant claims for this method, but merely suggested it as a guide in diagnosis and treatment.

THE STANTON METHOD OF ARCH PREDETERMINATION

The question of arch predetermination has received a decided stimulus from the efforts of F. L. Stanton, whose researches in this subject have extended over a number of years. In his earlier efforts, he attempted to apply engineering

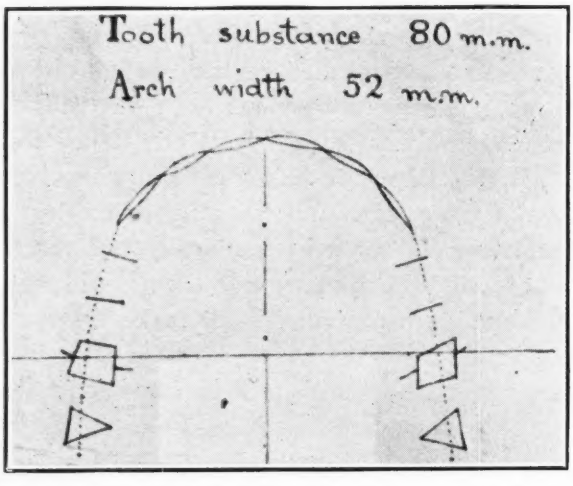

Fig. 20.—The outline of a normal arch of given tooth substance, according to Gilpatric's plan.

principles to orthodontia, but was not satisfied with the results, owing to the fact that such a method required so much labor on the part of an engineer that it was impractical. He therefore discarded this method, and in cooperation with a civil engineer, devised a new method which was mechanical and made possible through an instrument for arch determination which they have called the occlusograph. According to my conception of it, Stanton's method is founded upon the assumption that the form of the arch varies according to the amount of tooth substance contained within it. He, therefore, measures from perfect plaster models the greatest mesio-distal diameters of the teeth, and then relies upon his occlusograph to determine the arch outline in the following way. This instrument is supplied with a series of links corresponding to the number of teeth present in a perfect arch, these links varying in length to correspond with the various mesio-distal diameters of the teeth they represent. These are placed in series when a given arch is to be analyzed, the links used corresponding exactly in size with the teeth they represent. Thus two series of links are arranged, one for the upper teeth, and one for the lower, and the two series fixed to each other

in such a relation that the teeth will be in perfect occlusion. In order to accomplish this, the distance from the buccal cusps to the center of the fossa on the occlusal surface of the teeth is measured in the molar and bicuspid region so that the correct overbite can be selected. The upper and lower series of links are clamped into position, as shown in Fig. 21, the two crossbars being used to obtain symmetry of the arches.

The idea involved in attaching together the two sets of links representing the upper and lower teeth is to determine the form of the arches, as the two are modified until a correct occlusal relationship is established between them.

Not only does Stanton believe that the form of the arch varies according to the amount of the tooth substance within it, but he says in speaking of the form of the arch that "the whole arch depends on the interrelation of the sizes of all of the teeth, all dimensions of the teeth, and all parts and forms of them. If you should have in two cases, the same teeth, the only exceptions being in the two

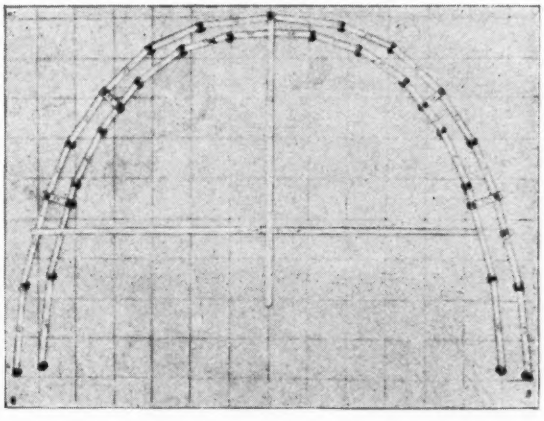

Fig. 21.—The occlusograph.

incisors, and they should vary only two millimeters, the entire arch would vary. The smallest change in any tooth produces a material change in the form."

Manifestly, it would be unjust to the method and to its author to comment upon it favorably or unfavorably without being in possession of all of the facts concerning it therefore, I must refer those interested to the various articles already published regarding it, so that they may draw their own conclusions.

THE WILLIAMS METHOD OF ARCH PREDETERMINATION

This method is based on the hypothesis that in the normal arch there are five points which lie upon the circumference of a circle, the center of which is midway between the two first molars on a line joining their buccal grooves. These five points are the buccal grooves of the first molars, the tips of the canines, and the point between the central incisors on the median line. Since three points on the anterior curve fall upon the circumference of a circle, the curve of the anterior teeth is considered to be an arc of a circle.

Following out this hypothesis, Williams' associate, Sved, has worked out a mathematical formula, by the use of which the dimensions of the arches can

be calculated from the measured mesio-distal diameters of the teeth. As I have already dwelt at some length upon the findings of Williams and Sved, they will not be considered further at this time.

THE GILPATRIC METHOD OF ARCH PREDETERMINATION

Like the methods already described, the Gilpatric method is founded upon the assumption that the form of the arch varies according to the amount of tooth substance contained within it.

After analyzing arches which varied in tooth substance from 78 mm. to 101 mm. for the upper arch, measuring from the buccal groove of one first molar to the buccal groove of the other first molar, and the corresponding tooth substance for the lower arch, which he found varied with the upper from 8 mm. to 12 mm., he has from his analyses produced a set of charts showing the dimensions of the arches varying between the extremes mentioned.

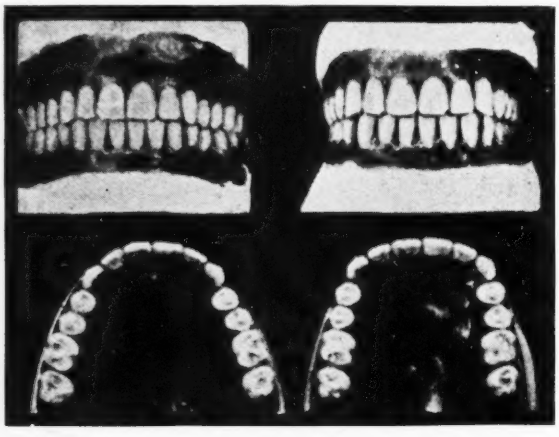

Fig. 22.—Illustrating the effect of correct and incorrect proportioning of the dental arches. (After Percy Norman Williams.)

As stated previously, in order to arrive at a definite idea of the arches of a given tooth substance, Gilpatric duplicated the natural teeth with trubyte artificial teeth, which he placed upon an anatomic articulator, subjecting them to all the various movements of occlusion, modifying the shape of the arch until all such movements were possible.

When this point had been reached, each arch was surveyed so that the arch form could be recorded, and from these records a set of charts has been produced which Gilpatric has called *orthodontographic charts.*

Fears have often been expressed and objections raised to injecting into dentistry any mathematical or mechanical method for predetermining the shape and size of the dental arches. One of the chief objections offered is that such a plan, if adopted, would eliminate the exercise of artistic judgment in our work. If the dental profession were filled with artists, this objection might be considered logical, but as stated before, an examination of the mouths of the majority who wear full upper and lower dentures and of those who have had their mouths subjected to the vagaries of hit or miss orthodontia, bears eloquent testimony

to the fact that almost any plan founded upon normal anatomic principles as well as on recognized principles in art would be far more safe for the profession to follow.

It is safe to say the majority of patients who have undergone orthodontic treatment have not received the maximum benefit possible, owing to the fact that the operators have tried to establish arch form in accordance with their own set ideas of what the patient needed. A close analysis of the majority of cases of malocclusion shows the need of expansion in the lateral half of the arches. (Fig. 22.) Instead of carrying this expansion to the needed degree, the average operator will push the anterior teeth forward and create a long narrow arch, which is, in the majority of cases, both incorrect anatomically and artistically. The laity have commenced to realize this, and orthodontists are often being asked by solicitous parents who are considering orthodontic treatment for their children, "Doctor, will this make my child look too mouthy?" This shows that parents have noticed the mutilating effect of arches created without any definite idea of what constitutes normal arch form and which in reality are created only with the idea of getting all the teeth in the mouth arranged in a concentric line.

I am convinced that if those who are interested in establishing normal arch form would adopt as a guide in their work any plan of arch determination which is based upon the amount of tooth substance contained within a given arch, and upon recognized anatomic principles, will render a far greater service to his patients than is possible to him who depends upon his "Eagle Eye" to guide him on his way.

DEPARTMENT OF
ORAL SURGERY AND SURGICAL ORTHODONTIA

Under Editorial Supervision of

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PERVERTED "FUNCTIONAL" ACTIVITY IN THE PRODUCTION OF JAW DEFORMITIES*

By D. M. Shaw.

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THE "perverted" or nonnormal activities which it is desired here to draw attention to are "functional" only in so far as they are excited and exhibited in the oral preparation of alimentary substances. The "jaw deformities" that it is hoped to throw some additional light upon are those occurring among children, and chiefly recognized and estimated (in occlusion) as irregularities or abnormalities in the position of teeth, the teeth themselves emerging structurally sound and normal in shape. The various dental units are constructed faultlessly and are ready (we may assume) *to time*. They are then potentially available for building into a machine which is highly efficient as a food-preparing mechanism when the units are normally arranged, which then also, when normally exercised, is adapted to maintain the health and integrity of its various parts and investing tissues. But in the abnormalities frequently seen the functional efficiency is greatly depreciated; the specific shapes that in man have for ages remained morphologically constant are there present, but the teeth are thrown together in such disorder as to more or less abort their utility, and the normal *rhythmical* activity in mastication becomes impossible. It will be agreed, and without touching at all upon the many other consequences involved, that this is a somewhat poor beginning for that part of the alimentary processes over which we could safely exercise the most direct and most knowledgable control.

THE "SOFT FOOD" THEORY

Any references to current theories of causation will here be closely restricted to what may seem helpful in bringing my proposition into reasonably clear view. Absence or insufficiency of the harder foodstuffs has long been held to be a dominant cause of malocclusion. The "soft food" theory and the indicated remedy have been insistently kept in the forefront by several accepted authorities, and in

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the general lay and professional mind there is, at any rate, a pious if not a very active belief in the soundness of that view. While no one seeks to deny that by lack of functional exercise the jaws *may* fail to attain their full development, there are yet many groups of malocclusion cases (involving protrusions, retrusions, contracted arches, spread arches, and excessive anterior overlap) wherein this explanation has been rejected by the majority of those interested in the subject. The limb muscles of different children undergo widely differing amounts of exercise; in many individuals the exercise may be deficient in amount, but no concomitant bone deformity ensues.

Professor A. Keith, whose suggestion that the "sensitizing" action of the pituitary secretion may be at fault was so finely lit up by the searching beam he cast into the less-explored field of comparative odontology, is at the same time in entire agreement that one should also give exhaustive attention to those "grosser" agencies which are known to alter and regulate growth—"the mechanical impulses which arise from the natural use of parts."

Quite a number of alternative explanations have been offered with varying degrees of confidence and support, the difficulty and low solubility of the problem being illustrated by the emergence, for example, of theories of causation, some of which are diametrically opposed—viz., the theory held by Dr. Sim Wallace and Sir Arbuthnot Lane that contracted or narrow jaws are caused by a feeble musculature of the tongue resulting mostly from the use of *soft* food, and the explanation advanced by Professor H. P. Pickerill that narrow jaws are due to the use of food that is too *hard* or *tough*. Again, in regard to defects or wrong use of the respiratory parts as a factor in jaw deformities, although the vitiating physical or mechanical conditions that exist during *free mouth* breathing are distinctly different to the conditions during *obstructed nasal* breathing, and therefore the effects directly due to the former must differ markedly from those due to the latter cause, yet in articles and discussions those important differences are usually either glossed over or ignored.

THE EXISTENCE OF POSITIVE FACTORS

Whether or no in modern times a harmful change has taken place in the kind of food given to children, the number of meals per day has probably not lessened and the total time given to eating may be taken as not less now than was customary among children in the near or more distant past. Therefore, as the mouth is in *some* kind of activity during that time, inquiry into the effects or defects arising should not be confined to consideration of the merely passive or negative factors. The absence of positive factors can not be assumed, and they should be searched for and their value as far as possible ascertained by close and persistent observation of the *machine at work* in large numbers of children. For some years past I have missed no opportunity (and have artfully created a good many) of observing the different ways in which the mouths of children deal with food.

A direct view of what is going on in the mouth is, of course, very much cut off and masked by the cheeks and lips, but this drawback is in some degree compensated for by the fact that watchful observation of those same moving curtains

will often betray what is happening behind the scenes. Correct interpretation of the mouth and jaw movements which take place and of the probable results of the various efforts in manipulating food will, it is reasonable to believe, be favored a good deal by previous close study of the chewing mechanism in children and adults, and not only in normal but also in abnormal, crippled, and mutilated dentitions. The small amount of interest up to the present taken in the physiological morphology does not warrant, however, the entering into details, "tedious" details that are in reality essential in this as in any other mechanism. The following is a rough summary of the results of observation of many groups of children.

1. There is in many cases an excessive amount of manipulation of food *by the tongue*. The tongue movements vary from very languid to very energetic, sweetened foods usually exciting the tongue to the greater activity, especially in upward pressure.

2. The normal work of fine reduction *by the cheek teeth* is only partially carried out and is often not performed at all. Morsels are merely rolled about in the mouth, with an occasional squeeze from the tongue or teeth, and what are in reality remarkable feats of food bolting pass quite unnoticed. The performances of some of these juvenile, yet often well-mannered, "bolters" are so mysterious and *finished* that it is almost impossible to understand how it is done.

3. Certain foodstuffs which constitute a large proportion of the daily intake (including cereals and breadstuffs permeable and softened by saliva, sweetened puddings, etc., porridge, sweets, jam and confectionery) are manipulated and "mashed" by the tongue *against the anterior surface of the palate*, partly to break up their consistency and partly to develop and extend the gustatory enjoyment. Sucking actions are often involved, and among the several *reflex* actions excited by very sweet substances is a frequent strong pressure of the anterior dorsal surface of the tongue against the front of the palate. In these various movements the muscular pressure exerted by the tongue is *many times greater* than that required either for the successive liftings of portions of food into position between the cheek teeth or for moving food from one part of the mouth to the other. Here we have a kind of "tongue mastication" (*vide* Mr. J. G. Turner) which, while admittedly falling within the limits of normal function when performed occasionally, becomes *abnormal* or perverted when exercised frequently and to the extent of in large part supplanting normal mastication by the cheek teeth.

4. In some children—more usually of the "vigorous mouth and hearty eater" type—the reduction of *tough* morsels is to an abnormal extent effected *by the anterior teeth* instead of by the cheek teeth, which latter teeth may either be absent or crippled by caries, or, if present, they are thrown out of effective shearing alignment by a malocclusion already established. In this type the cutting edges of the anterior teeth are found to be more worn—and to an undue or abnormal extent—than those of the posterior teeth. Later on one may often observe premolars and molars that have been fully erupted for several years and yet show not a trace of intermaxillary attrition or of food abrasion. Now, when for any reason fine (or moderately fine) reduction of tough food is attempted by the incisors alone, the tongue has to exert considerable upward and *forward* pres-

sure in order to *hold the small morsels in proper position* for each successive shearing stroke. This work of reduction (which by the arithmetical increase of the divided fragments must constitute by far the greater part of the total masticating effort) is effected normally by the multi-bladed cheek teeth, in which the rows of lingual cusps automatically, as it were, hold and support the fragments in position, and without calling for more than the very lightest use or pressure of the tongue.*

SOME PREDOMINANT FEATURES IN MALOCCLUSION

The bearing of the above-mentioned perverted activities of the tongue upon jaw deformities may here be best brought out by a short consideration of certain features that are often found associated in various classes of malocclusion.

Twenty years ago (1899) the adjourned discussion of a paper on "The Treatment of Superior Protrusion," read by Mr. J. F. Colyer at the Odontological Society of Great Britain, included a full and interesting contribution from Mr. E. Lloyd-Williams on the etiology of that deformity. In the discussion following—deservedly a "classic" upon the particular subject—all the known explanations were in turn advanced, excepting perhaps only the ductless gland theory and the antenatal and parturition theories. Yet as one of the speakers very moderately expressed it, "there was still something missing in all the hints which had been thrown out with regard to causation."

There was general agreement upon the points mentioned by Mr. W. Hern and Mr. Lloyd-Williams as to the following three or four abnormalities found associated in the majority of superior protrusion cases: (1) The high level attained by the alveolar anterior border of the mandible: (2) shortening of the body of the mandible; (3) the increased depth or low level of the premolar and molar region in both maxilla and mandible; (4) some narrowing of the arches; (5) a backward "bite" of all, or nearly all, the mandibular teeth.

SIGNIFICANCE OF THE ABNORMAL VERTICAL OVERLAP

The high level or uprising of the incisive border of the mandible involves, *ipso facto* (excepting only in cases of "open bite") an abnormal degree of vertical overlap in the occlusal relationship of the incisors, the opposed incisors quite often overlapping one another to the full length of their crowns—that is, from two to three times more than the normal amount. Now it is a remarkable and perhaps hardly recognized fact that if and when—from whatever cause—this excessive overlap is in any particular case once established, the several other abnormalities set out above must then of mechanical necessity be concomitant, if not actually consequent, features. This statement requires qualifying in regard to the fourth abnormal feature, inasmuch as the arch in some cases does not undergo a *general* narrowing. But excessive overlap must in most cases involve a narrowing of, at any rate, the anterior portion of the mandibular arch, because the lower anterior teeth are shifted to a smaller "circle" (shorter tract) within or behind the lingual walls of the upper ones; the only two alternatives

*"Mechanism of Mastication in Man," Trans. Sixth Internat. Dental Congress, p. 63 et seq. "Form and Function of Teeth," Jour. Anat. iii, October, 1917.

possible being a broadening (anteriorly) of the upper arch, or an excessive retrusion of the lower one. Excessive overlap is a feature of many cases other than those of superior protrusion, and the search for its origin—as probably the master-key to the casual explanation of many jaw deformities—has always made a fascinating appeal to the writer.

PERVERTED ACTIVITY OF THE TONGUE PRODUCES DEFORMING STRAINS IN THE TOOTH-BEARING TISSUES

The tongue is drawn forward and pressed against the lingual walls of the upper anterior teeth and anterior surface of the palate chiefly or almost entirely by the contraction of the geniohyoglossal muscle. Although theoretical consideration of the normal anatomy and physiology of the parts might bar out any dispute upon that point, it may be well to mention in addition the following demonstrable evidence: 1. Subjective experiments by the writer and some others in whom the lower premolars were missing. By inserting a hooked finger at the angle of the mouth the strong contraction of the genioglossal muscle could be distinctly felt whenever the tongue was thrust upward and forward as described. 2. Experiments upon two subjects in whom the symphoseal portion of the mandible had been removed, and as a consequence the tongue (sound and about normal in size) could not be protruded beyond the lips, and even when the tongue was kept inside the mouth no *forward* pressure could be exerted with it.

It is clear, then, that by the contraction of the genioglossal muscles the lower jaw is subjected to a backward pull at and about the region of the genial tubercles, which backward traction is abnormal just in proportion as the forward thrust of the tongue is abnormal in force annd frequency of action. This backward pull is in daily operation during the four or five years' reign of the deciduous dentition, and, in addition, throughout the period of change to the permanent dentition. During most of that time the horizontal U-shaped cortical tube of a child's mandible is a frail box almost "cram full" of teeth. Moreover, the strut-and-stay system of trabeculæ, the tooth crypts, and to some extent even the cortical bone of the main beam, are undergoing a constant process of breaking down and reconstruction; the alveoli, too, are in turn "swept away" —as Sir C. S. Tomes describes it—and rebuilt. Even in the completed jawbone of the adult the long-continued action of abnormal stresses brings about bending and shearing strains that in time appear as obvious deformities; the striking deformity observed (in the horizontal branch of the mandible) in some cases of ankylosis has been attributed by Dr. M. H. Cryer to the abnormal action of the *depressor* muscles, the power of which is, nevertheless, thought to be fractionally small compared with that of the elevator muscles. The more readily, then, will one admit that during the growing and reconstruction period the reaction of the mandible to abnormal stresses may take effect both in inhibiting and disorganizing growth and producing durable strains (deforming changes of shape) whenever the stresses exceed certain limits of force and time (or frequency) of action. These limits are known to be low for young children; in the routine practice of orthodontics they are purposely overpassed by the artificial application of very small forces.

I have estimated quantitatively the force of the tongue's upward and for-

ward thrust, and although my measuring apparatus is too crude and imperfect to warrant presenting figures, I am quite satisfied that this force is many times greater in amount than that effectively used by dentists to move teeth and alveoli—often, too, in the permanent dentition.

Those who regard with some doubt the various explanations that the mandibular retrusion is due to "want of development," "heredity," "small tongue," and other suggested factors that are ill-defined and mostly negative, will be glad to turn to the consideration of a positive factor that can be *seen in action,* that acts in the precise direction required to produce the observed phenomena, and the more hidden results of which in changing the normal disposition of the bony tissues can be further investigated by x-ray examination and also in the dissecting room. In some cases it may be that the backward or centripetal pull of the genioglossal and "sublingual" muscles produces retrusion of the mandible solely or mainly by *inhibiting or restraining its development.* But to deny or exclude the possibility of actual deforming *strains* (that is, slow yielding of the bony tissues) occurring, would be to make a unique exception of a particular part of the jaw, and to endow it with an unknown superresistant quality. And if growth-inhibition or yielding from backward traction *did* in point of fact occur, the resulting deformities would be exactly like those that confront us daily and with increasing frequency, and that, in this country alone, must affect many thousands of children in whom the handicapping disorder will not be treated or ever right itself.

I turn now to the *excessive overlap* or (what is practically the same thing) abnormally high level of the incisive border of the mandible. The majority of observers are agreed that the causes of this very common deformity, by no means confined to superior protrusion cases, "remain shrouded in sphinx-like mystery." Explanations such as "pressure of the lower lip," "eruptive pressure of the canines" have been somewhat waveringly offered, and in application to but a few cases only the explanation I here advance applies to a wide range of cases, possibly to nearly all cases of excessive overlap.

It can be shown that the part of the tongue whereat (during eating, sucking, etc.) pressure is applied against the palate and anterior upper teeth lies at a *higher level* than the bony area of attachment of the genioglossal muscle. Therefore in the resistant pull of this muscle upon the tongue there must be a *downward* as well as a backward component, the general substance of the tongue being at the same time stiffened to a quasi-rigidity by a number of other muscles, the coordinated actions of which it is needless at present to attempt to analyse. When holding the raised tongue against the resistance offered on or at the anterior maxillary surfaces, the genioglossal fibres are perforce inclined markedly upward so that (reaction being equal and opposite) their contraction must exert an obliquely *upward* and backward pull upon their place of origin on the mandible. The existence and the strength of this upward pull can be felt and realized when (under the conditions described), with an inserted finger, an attempt is made to press or keep the converging anterior part of the muscle down. Under this upward tensional stress the *young "unready" bone is strained* and very slowly and gradually *yields in an upward direction.* The force of the

pull is distributed on and about just that very region where the apices of the milk anterior teeth and the crypts of the permanent ones lie, so that it would undoubtedly tend to produce the unexplained variey of phenomena found associated with uprising of the alveolar border—"apical crowding" and anterior "crowding" with or without spacing of the crowns, the "fan" arrangement, and the (hitherto) completely puzzling type mentioned by Sir Harry Baldwin, wherein the lower incisors "were jumbled together into two lines."

And the "low level" of the mandibular postcanine teeth is a further and almost inevitable consequence ensuing from the downward component of the tongue's pressure upon the diaphragmatic floor of the mouth, whereon the base of the muscle-stiffened tongue finds the necessary resistance to its own upward thrust. The digastric and geniohyoid muscles play a considerable part in supporting the upward thrusting tongue, but certainly the mylohyoid "slings" upon which the tongue is seated must exert a downward pull upon those inner surfaces of the mandible from which they are hung. Experimental trial (subjective and objective) readily shows that in reaction to the tongue's upward thrust the downward bulge of the oral floor is both seen and felt to be lowest or most prominent in the region of the lower premolars and first molars, where, as it happens, the "low level" of the alveolar border or teeth is found to be the most marked. It is worth noting, too, in view of the downward traction internally, that the mandibular cheek teeth often have an abnormally inward tilt.

The pull of the mylohyoid (under the tongue's perverted activity) will of course vary in strength and *direction* with the individual, and with the varying proportional development of the different tissues, including the tongue itself. So that when the tongue is (constitutionally?) small and narrow, the supporting mylohyoid sheet may attain a more nearly horizontal plane, and its pull will then be the more directly *inward,* tending to draw the two sides of the mandible together. Thus if a tongue small or subnormal in volume is found associated with a narrow arch, the usual explanation that the small tongue (negatively or by its passivity) causes the narrow arch may be wrong, and is based too much upon assumption. The significance, if any, of the association can be more instructively interpreted by taking into account the more horizontal direction of the contractile pull of the mylohyoid upon the mandible. A large tongue will, on the other hand, the more deeply bulge into and fill the oral floor-space, partly overcoming the resistance of the mylohyoid sheet and causing its pull upon the mandible to be more downward and less inward. In regard to the inward traction the following observation may be significant.

During the routine examination of many thousands of occluded plaster casts, I observed that in a proportion of those in which the occlusion of molars might be reckoned as good mesiodistally the occlusion buccolingually would have been better or more normal if the mandibular molars were moved buccally or wider apart —that is to say, the mandibular arch was a little too narrow at the first molars for the normal occlusion of these teeth with their maxillary opponents. This in itself suggests the possibility that in some cases the *lower jaw leads the way* in the contraction of both arches.

In conclusion, it is urged that what I have called (in short phrase) "per-

verted activity of the tongue" is harmfully frequent among children, and is incited chiefly in the oral manipulation of foods a *preponderant* amount of which is of a sweet, soft, or glutinous nature; and also less frequently by the crippling or (from whatever reason) insufficient use of the cheek teeth.

At the same time it is possible to go to the other extreme by encouraging young children to masticate well an unduly large proportion of tough food, so that the anterior teeth are to an undue extent called upon to relieve the overworked cheek teeth in the extra labor of fine reduction; the forward-thrusting and holding action of the tongue is thus brought into too frequent use, and the mandible is subjected to an upward and backward traction. In several reported cases (including children of dentists) where the precepts of vigorous mastication were faithfully and conscientiously put into practice, the deciduous arches were seen to be broad and fine, and the teeth individually were in every way satisfactory; nevertheless, the puzzling excessive overlap was there, as well as some degree of post-normal occlusion.

That the forward thrust of the tongue during its perverted activity must, in some cases, induce protrusion of the *upper* teeth is so evident a proposition that I omitted any explicit statement on the point, and detailed discussion is here barred out for want of space. But what I regard as remarkable and important in my discovery (about five years ago) of the tongue's abnormal activity, is its unsuspected yet inevitable reaction on the mandible. The tongue exerts a *centrifugal pressure on the maxilla* anteriorly, and the main resistance and reaction to the tongue's thrust takes effect as a *centripetal traction on the mandible,* the one being in effect the reciprocal of the other.

The great majority of superior protrusion cases are associated with inferior retrusion, as stated by Mr. Norman G. Bennett when reporting (March, 1912) to the British Society for the Study of Orthodontics, for the Committee on Orthodontic Classification. The degree of superior protrusion actually produced during functional activity must depend upon the greater or less amount of counteracting restraint and inward pressure from the upper lip, which effective centripetal pressure varies, I think, not so much or so entirely with the length, thickness, or "poise" of the lip as with the "temperamental" and muscular *motility* in the particular individual. This line of investigation may seem too obscure to bring out anything helpful, but in point of fact striking differences in the functional labial movements of different individuals are made evident merely by visual observation. More important, however, and more directly bearing upon my present thesis concerning the identification of primary causes and the actions they evoke, is the marked influence of *reflex* movement and pressure, here just touched upon as follows.

GUSTATORY REFLEXES

Among the oral *reflexes* incited by sweetened food and sweet substances, as well as substances with an acid or a "sharp" taste, there are certain labial and buccal muscular actions which very probably play a part in the contraction of the upper arch. Discussion of this would be quite relevant, but must be deferred.

I propose in a future communication to show that perverted activity of the tongue may also bear a causal relationship to two other deformities of the jaw—namely, (1) inferior protrusion or "underhung" bite; and (2) open bite.

DEPARTMENT OF DENTAL AND ORAL RADIOGRAPHY

Under the Editorial Supervision of

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It is the object of this department to publish each month original articles on dental and oral radiography. The editors earnestly request the cooperation of the profession and will gladly consider for publication papers on this subject of interest to the dental profession. Articles with illustrations especially solicited.

DESCRIPTION OF CASE AND OUTLINE OF TREATMENT

BY B. FRANK GRAY, D.D.S., SAN FRANCISCO, CAL.

ANOMALIES of dentition are of more than usual interest to the orthodontist. There ever recurs the question of etiology in such cases, and so far I think it has never received a satisfactory answer. Congenitally missing teeth afford ample opportunity for profitable discussion, and our skill is taxed quite sufficiently in the matter of successfully treating our patients who present such discrepancies.

Radiograms are shown of a girl thirteen years of age. Both of the mandibular second bicuspids are absent. The same is true as to the maxillary right second bicuspid and both the first and second left bicuspid. It will be noted in Fig. 3 that the maxillary right bicuspid is "impacted" to the lingual of the cuspid tooth. Note also the deciduous cuspid in its normal position.

In the absence of model illustrations, please bear in mind carefully the outstanding characteristics as to the occlusion, as follows: The first molars are in "end-to-end" occlusion. The mandibular incisors occlude with the maxillary incisors at the gingivæ, while the latter teeth are separated somewhat and protrude approximately a full quarter of an inch.

The radiograms show the second deciduous molar teeth possess very well-formed roots, and little or no absorption is in evidence. Ordinarily one might expect those teeth to remain in place and give service for a good number of years. It is believed, however, the better treatment of the case would be to remove these deciduous molars, and bring forward the first permanent molars. It is to be remembered the treatment of this patient calls for increased vertical development in the molar region. Those who have endeavored to bring about any considerable change in the positions of the deciduous molars under such circumstances will doubtless agree their period of usefulness would be materially shortened in any endeavor to bring them up (or down) to a new occlusal plane, such as would be established by the first permanent molars.

Fig. 1.

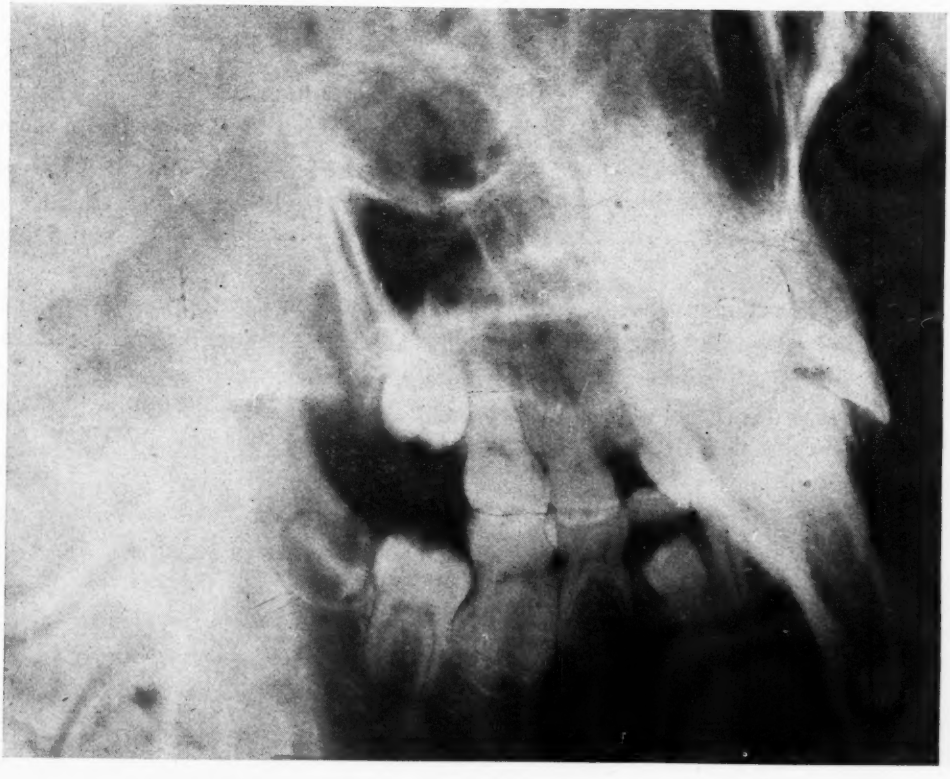

Fig. 2.

The maxillary right deciduous cuspid should be removed, and the permanent cuspid tooth brought forward somewhat, permitting the impacted first bicuspid tooth to erupt.

With both bicuspids absent in the upper left, a bridge will be necessary. Since the maxillary third molar is congenitally missing on the left side, it may be well to allow the first molar to retain its position, thus providing for its occlusion ultimately with the mandibular second and third molars. Of course this method will make necessary a bridge of two teeth. The other course might be followed; i. e., the moving forward of the maxillary first molar. Under that procedure but a single tooth would have to be bridged in, which doubtless is a valuable consider-

Fig. 3.

ation, but it would leave the mandibular second and third molars with but little function to perform.

It may be thought by some that to follow the course outlined entails much serious work, and so it does. But an essential of the treatment is to secure vertical development in the molar region. That very requirement is most apt to render the second deciduous molar teeth useless in a very short period of time, when the patient will awaken to the fact that four bridges instead of one are demanded.

Doctor Robert Dunn and myself are of the opinion the treatment as briefly outlined is the one indicated in this case. Doubtless some different opinions may be held by others. In any event the radiograms are presented, with the foregoing suggestions, believing that anything along this immediate line is timely.

ABSTRACT OF CURRENT LITERATURE

Covering Such Subjects as

ORTHODONTIA — ORAL SURGERY — SURGICAL ORTHODONTIA — DENTAL RADIOGRAPHY

It is the purpose of this JOURNAL to review so far as possible the most important literature as it appears in English and Foreign periodicals and to present it in abstract form. Authors are requested to send abstracts or reprints of their papers to the publishers.

Operative Treatment of Fistulas of Steno's Duct. P. Sebileau. Bulletin et memories de la Societe de chirurgie de Paris, 1919, xlv, No. 26, p. 1220.

Fistulas of Steno's duct following upon war traumatisms are less common than fistulas of the parotid gland, but on the other hand more serious, for the latter usually heal at the end of a few months by Nature's unaided efforts, whereas this outcome is exceptional in the former. In the course of the war, the author observed about ten cases of Steno's duct fistulas, all of which with a single exception were operated upon and cured. In one case, the patient's cheek was found to contain a large wooden splinter, driven in by a bursting shell, small abscesses, followed for a few days by a scanty discharge of saliva, still formed from time to time, after the performance of two operations. There are three distinct groups of cases; in the first, the exposure of Steno's duct permits the discovery and approximation of its two extremities, in the second, it permits their discovery, but not their approximation, in the third it permits the discovery of the upper, but not of the lower extremity. The end with the fistula was never missed by the author, who devised a special procedure for each of these varieties, but always based upon the same idea. Drainage towards the mouth, along threads passing through the cheek, of the saliva dripping from the upper orifice of Steno's duct. All these operations have the first stage in common, namely, the treatment of this orifice. Two or three thin silk or linen threads are passed through the trimmed end of Steno's duct, each of these threads forms a loop around the cut end and terminates in two floating threads which must not be tied together. The second stage varies according to the anatomical conditions. All the ends of the threads having been grasped in a buttoned stylet, this instrument is buried in the buccal cavity as follows: In case the lower end is within reach, the stylet armed with all its threads is passed into it; these threads penetrate into the mouth through the anatomical orifice of the canal, after having circulated in the cavity of the duct. The two extremities of this canal are then brought together and sutured; the threads become invisible. When, on the other hand, the two extremities can not be approximated, the threads after having been inserted in the lower end, are left in midst of the cellular tissue of the cheek, and will remain visible in a portion of their course. When the lower extremity of Steno's duct is not demonstrable, the buccal mucosa is opened as close as possible to the

anatomical entrance of the canal, and the threads are passed through the established gap, in this case, they remain visible in the thickness of the cheek. No matter what has been done, the threads are collected in a slender bundle which is brought out of the buccal cavity through the corresponding labial commissure, and they are fixed on the skin with a small piece of adhesive plaster. At the end of a week, they are all withdrawn by means of simple traction on one of the extremities of each thread. As far as practicable, the fibrous scar-tissue produced by the cicatrization process of the traumatism is resected, and the two lips of the surgical wound are sutured without drainage. Usually, a slight swelling of the tissues occurs in the days following upon the operation; the surroundings are reddened, the cheek becomes hard, and a mild inflammatory reaction develops. A slight sero-purulent discharge was repeatedly observed by the author. At the end of two, three, or four weeks, normal conditions are restored, and the fistula has closed.

Oral and Plastic Surgery in the Intermediate Section of France. H. A. Potts. Journal American Medical Association, 1919, lxxiii, No. 16, p. 1184.

This interesting contribution being easily accessible in the original, the excerpt is limited to the part dealing with the removal of foreign bodies as practiced at Base Hospital No. 202. The method consists of a table beneath which is a movable roentgen-ray tube, the vertical ray of which is directed upward through the foreign body. The fluoroscope, also adjustable and at right angles to the vertical ray, is lowered on the part. The movement of the tube marks the excursion of the body on the fluoroscope. Blunt artery forceps are then placed on the skin at the supposed depth of the foreign body. The tube is again moved, and if the excursion of the tip of the forceps coincides with the excursion of the foreign body, it is exactly at that depth. The forceps are then held to mark the spot on the skin, the headlight of the operator is turned on, and a button hole incision is made in the skin. The forceps are introduced, and under the fluoroscope are carried by a boring motion to the foreign body, which is grasped by the forceps and extracted directly under the eye. From one to five minutes is consumed by the whole operation, and there is no mutilation of the tissues. More than four hundred foreign bodies were in this manner removed, with 100 per cent success.

At the earliest possible moments after injury, all foreign bodies, including detached bone fragments and tissues injured by the missiles, should be cleanly dissected out, as the lacerated soft tissues do not retain their vitality and subsequently become culture mediums for bacteria. Reduction of fractures, immobilization and retention of fragments, together with adequate drainage, established with the idea of its continuance much longer than in wounds of other parts of the body, were the aims of the maxillo-facial staffs within the intermediate section.

The Use of Maxillary Prostheses. F. Garcia del Villar. La Odontologia, 1919, xxviii, No. 7, p. 337.

In the surgery of the mouth, and more particularly in maxillary surgery, a most important part is played by the odontologist. A close collaboration between the operating surgeon and the odontologist must be maintained during the entire

course of treatment, especially because the only efficient curative procedure in these cases is the application of a prosthetic apparatus made for each individual case, necessarily requiring the intervention of a trained odontologist. The employment of bone-suture is rejected by the author in all cases, in spite of the fact that bone suture is recommended as a routine procedure by certain operators. His refusal is based on personal observation of numerous cases treated by this method, which regularly presented more or less considerable deformities of the bony framework of the face and consequently of the soft parts, leading to a change in the function of the mouth. Bone-suture involves further disadvantages of an equally serious character, such as infection of the focus, rarefaction of bone due to mobilization of the fragments, necessity of another operation for the extraction of the metal clamps used in the suture, formation of scar tissue, etc. For all these more than sufficient reasons, the author makes no use of bone suture in his practice in the Hospital Real de Santiago de Compostela, in Galicia, Spain. The enormous number of cases observed in the war has served to confirm these views as well as to modify other ideas as to the behavior of the surgeon in cases of fracture of the lower jaw; in favor of more conservative methods, with preservation of the bone-fragments and removal of necrotic parts exclusively. In cases associated with an extensive loss of substance, an immediate prosthesis should be applied, with the object of preventing the formation of cicatricial contractures and deformities difficult to correct. As regards the points of fixation of the prosthetic appliances, in this group of cases, the author utilizes all available teeth, on the principle of fixation in movable bridge work.

Oral Surgical Cases in Practice. S. L. Silverman. The Dental Cosmos, 1919, lxi, No. 10, p. 942.

The first observation concerned a man 42 years of age with an impacted lower third molar lying directly under the second molar. According to the author's maxim that all impacted teeth should be removed, whether or not obvious causative factors in local or constitutional disturbances, the third molar was removed, as well as the second which was undermined by a suppurative and destructive process. Recovery was uneventful, and the general nervous symptoms from which the patient had suffered for a few years past, were greatly relieved by the intervention. An accompanying figure shows the case several months later, with osseous reconstruction to a degree that insures more strength at this point of the mandible than it would have had even had the third molar remained in a healthy state. Another illustration shows the excellent results obtained in a case of single hare-lip in an infant, by means of the Owen operation, where only a single flap is used.

Actual wiring of the bone itself is advocated by the author as the only efficient procedure for the reduction and correction of fractures of the jaws, in those cases where no teeth or only a few teeth are present. In a fracture coming under this description in a negro of 47 years with an insufficient number of occluding teeth suitable for the application of an intra-oral appliance, an incision was made along the lower border of the mandible, the bone bared, and the wire inserted through the two holes, made sufficiently distant from the line of fracture

to insure healing. An illustration shows the case radiographed exactly two years after the operation, with favorable results too obvious for descriptive comment. The patient is totally unconscious of having any foreign object in his jaw, nor can any callus or wire be felt by palpating lingually and buccally. It is noteworthy that although the jaw is in perfect condition, the silver wire has broken into three pieces, as shown in another illustration.

Reconstruction Work in War Injuries of the Face and Jaw. Ivy, Eby, and Bodine. Journal American Medical Association, 1919, lxxiii, No. 18, p. 1337.

The successful treatment of maxillo facial injuries is known to depend on team work between the surgeon, the dental surgeon, and the dental prosthetist. The authors outline the practical application of this cooperation at the Walter Reed General Hospital where patients arriving from overseas are treated. In every case a thorough survey of the mouth is made, clinically and roentgenographically, to eliminate any factors capable of keeping up infection. All teeth in or near the fracture lines are extracted, bone cavities are drained, sequestra and foreign bodies are recovered. The splints employed in fixation of fractures are as simple as the nature of the case will permit. For many of the uncomplicated cases with many teeth and good occlusion, in which maintenance of reduction is easy, intermaxillary wiring of the teeth has proved efficient. For the majority of cases, the cast silver cap splint is employed. When there are firm teeth on both sides of the fracture it may be necessary to splint only the lower jaw, thus permitting mastication. For other cases the upper and lower teeth are splinted separately, the two splints being locked together in occlusion with a removable bolt on each side.

Two months of bone-grafting have been employed, in the form of Cole's method and the osteoperiosteal method of Delageniere, most of the cases proving unsuitable for Cole's method on account of being too extensive or situated at or behind the angle. Primary union followed the operation in all cases except one, in which it is hoped that union will still occur.

Etiology and Treatment of Pyorrhea Alveolaris-Stomatitis Ulcerosa Chronica. F. Forchheimer. Practical Medicine, Delhi, August, 1919, xvii, No. 8, p. 148.

As regards the pathology of this condition, the author points out the existence of two forms, the first of which marks simply the beginning of the disease and is limited to the gums at first finally involving the alveolar dental membrane and the periosteum, and therefore the alveolar process. An additional infection by pus producers results in the second form, or true pyorrhea alveolaris, the more common form of the disease. The process is originally a necrobiotic one, and therefore an ulceration, to which there is added a secondary suppuration, so that the term "Stomatitis ulcerosa" would seem to be the most appropriate term for this chronic affection. While the clinical course of chronic ulcerative stomatitis or "pyorrhea alveolaris," is somewhat different in children from what it is in adults, and while the etiologic factors are to a certain extent different, yet upon the whole the mechanism of production of this disease remains the same

in both classes of patients. The essential etiologic factor in the first process, referred to above, is a something that is eliminated from the general circulation by means of the mouth; secondarily, it is necessary to assume an infection with pus producers. The substances eliminated in this way include, as inorganic substances, lead, mercury, phosphorus; the organic substances are represented by certain toxins, the toxin of measles, for example, the toxins of a large number of the acute infectious diseases, possibly the ptomaines, as found in scurvy; finally, all the alloxuric substances which ultimately lead to the formation of uric acid. Although capable of producing by themselves the first form of chronic ulcerative stomatitis, these various substances presumably require the assistance of pus producers for the development of the second form or true pyorrhea alveolaris.

Concerning the treatment of this disease, the author emphasizes that every one of these patients should be treated both by the dentist and by the physician, the dentist impressing upon his patient the necessity for prophylaxis; and, when the disease has developed, treating the oral condition locally. The necessity for prophylaxis exists, first in the removal of all substances that irritate; and secondly, in applying methods calculated to carry out rational antisepsis of the mouth. As a matter of fact, the local treatment of the disease must be carried out on the same lines; and it is a great gratification to note to what extent and how skilfully and intelligently the American dentist carries out these indications. General treatment undoubtedly has its value and must be based on the removal of the toxic substances from the blood. The cases of chronic ulcerative stomatitis due to syphilis are notoriously the worst to handle; treatment by iodides, plus a general tonic course, will be found very valuable. Eliminative treatment for the control of chronic intoxications of all kinds consists in taking advantage of increased physiologic activity of the bowels, the kidneys, the skin, and even the respiratory apparatus.

The Course and Prevention of Dental Caries. G. E. Clemons. The Medical Journal of Australia, 1919, ii, No. 13, p. 257.

The subject of the cause and prevention of dental caries has occupied the serious attention of many workers, both medical and dental. The type of food as the main cause of decay in teeth has been discussed by a number of investigators, with special reference to its hardness or softness, the consequent improvement in the circulation and development of the jaws and teeth, and their effect in the production of acids and toxins by bacterial decomposition. Without wishing to underrate these factors, the author considers as a more important fact his repeated observation of signs of malnutrition in infants' teeth when, and as soon as they erupt. The malnutrition of these deciduous teeth is obviously due to some defect in the mother's blood, or the mother's milk or both. This problem is probably solved by recent laboratory experimentation along the line of accessory food factors and the vitamine content of various kinds of foods. Sufficient information as to the relative value of foods is now available to enable us to supplement children's and mothers' diets with the necessary vitamines. In order to supply her offspring after the first period of her pregnancy, the mother must have an adequate supply of them both during gestation and lactation. Vitamines should be added to the infant's diet, particularly for artificially fed babies; grow-

ing children need them as well. Food substances known to contain these vitamines are milk, meat, malt, yeast, codliver oil, etc. The combination of malt and oil for growing children suggests itself, and the author knows of children who have taken this for other purposes and have remarkably good teeth. A child's diet is most likely to be deficient in fat soluble vitamines from infancy to its second year, particularly bottle-fed babies who are given cow's milk diluted and rarely compensated for by the addition of cream. The diet of Maoris and Eskimos, who have by far the best teeth of all humans, apparently contains large amounts of fat soluble vitamines.

Trifacial Neuralgia Produced by Root in Maxillary Sinus. M. H. Feldman. The Dental Digest, 1919, xxv, No. 10, p. 583.

The author reports a peculiar case concerning a woman of 48 years who on account of severe nervous disturbances was about to be committed to a psychopathic institution. The teeth posteriorly to the right upper cuspid had been extracted many years ago, prior to the onset of the neuralgic affection in the right side of the face. Plate and film radiograms were taken and revealed a condition of empyema of the maxillary sinus, produced by the presence in the sinus of a portion of root apex of a molar. Operation was promptly resorted to, and the author removed three drams of pus and much necrotic tissue. The sinus was sutured immediately. At the time of this report this patient (who had been treated by neurologists for nervous trouble, with little relief) was enjoying perfect comfort and stability of the nervous system.

Is Pyorrhea Curable? H. Blackford. Medical Sentinel, 1919, xxvii, No. 10, p. 1090.

The nonamenability of pyorrhea to local treatment points to the existence of other contributory factors outside of infection in the etiology of this disease. The blood of these patients has lost its power of resistance through changes interfering with its oxidation and alkalinity. A very conspicuous part in reducing the oxidizing power of the blood is played by excessive carbon dioxide contents in the blood through faulty digestion; and pyorrhea is of rather common occurrence in patients whose blood is in such a condition. A considerable number of patients under the author's observation were treated for pyorrhea for varying lengths of time without any apparent results, until constitutional derangements responsible for the excess of carbon dioxide in their blood were corrected. In another group of cases, pyorrhea of a severe type is brought about through an acid condition of the blood, the result of a faulty diet. Accordingly, pyorrhea is not a mere local infection, but is a local manifestation of a constitutional disorder. The causes of pyorrhea are direct and indirect. A reduction in the oxidizing power of the blood through the absorption of various poisons, especially carbon dioxide, and an acid condition of the blood, are indirectly responsible for local chronic ulcerative changes, of which pyorrhea is a good example. Provided constitutional derangements, the predisposing causes of pyorrhea, are removed, this disease is eminently curable. An intelligent explanation to the patient as to the cause of pyorrhea would materially assist the dentist in the management of the treatment.

A complete history as to the patient's mode of living, habits, and various constitutional disorders should be taken by the dentist before he begins to treat him. The final word is: pyorrhea can be cured, but only by whose who have an understanding of the causes of it.

Treatment of Diseased Teeth. J. M. Green. Texas Dental Journal, 1919, xxxvii, No. 10, p. 3.

The efficient control of pain (odontalgia) requires in the first place the discovery of the cause of the pain, the relief of which is usually a simple matter. Most pains about the teeth are undoubtedly due to the inflamed pulp following tooth decay, but aside from carious conditions, pain in and around the jaws may be caused by pulp nodules, enlargements of the roots (exostosis), fractured or impacted teeth, too rapid movement of the teeth for separation, or in orthodontia treatment. In dealing with a throbbing or aching tooth, the dentist should always aim at maintaining the vitality of the pulp and restoring the tooth to usefulness. In hopeless cases of pulp congestion, rupture or puncture of the pulp tissue will afford the best means of relief, followed by the application of a soothing dressing or by devitalization and removal of the pulp. If infiltrative or conductive anesthesia is to be used in connection with destruction of the pulp, it is not advisable to puncture the pulp, as this usually causes severe pain, which will be avoided after anesthesia is produced. In the presence of a dead pulp and putrescent canals, the tooth should be opened into almost to the point of exposure, with the rubber dam in place. When the pulp chamber is almost reached, the burr should be withdrawn and the cavity be flooded with phenol, tricresol, or other powerful disinfectant. As soon as the pulp chamber is opened, the atmospheric pressure carries the disinfecting agent into the canal, with the result that the growth of the bacteria is immediately checked. This disinfection, with instrumental evacuation of the canals should be repeated, until at the third sitting, when conditions permit, the canals may be thoroughly cleansed and then filled, after having been enlarged to the required size. The author recommends an application of ammonium silver nitrate solution, precipitated with formalin, by a combination rotary and pumping motion, using great caution that none of the solution is carried past the apex of the tooth, if at all avoidable. Blind abscesses are treated in approximately the same way, except that provision is made for drainage before filling. Fistulous openings are cured by forcing first a saline solution, then phenol, through the entire tract.

Focal Infection. F. G. Connell. Wisconsin Medical Journal, 1919, xviii, No. 5, p. 157.

The author points out that focal infection has been looked at, as many other subjects have been during the last decade, from an ever specialized viewpoint. A focus of infection is a localized septic condition, a suppurative process, with or without local manifestations; that is, a primary source of secondary systemic intoxications or microbic metastases. It is not necessary for the production of systemic or remote effects for bacteria to be disseminated from a localized infection; their toxins may be absorbed and the resultant toxemia may exercise a

deleterious influence either upon the general system or upon special tissues or organs. Teeth the source of infection and bridge work and crowns that retain infectious material must be cleaned up or removed. Consultation and team work between the dentist and physician each benefiting from the other's special knowledge is most desirable. The recognition of dental infection may be easy if apparent, and should be corrected on general principles with or without secondary symptoms of focal infection. In the presence of symptoms indicating a focus of infection somewhere in the body, the teeth among other possible causes must be suspected, and it is then that the x-ray is invaluable, especially in the blind abscesses or dental granulomas following devitalization of teeth. While a most valuable adjunct in the diagnosis of peridental infections, the dental roentgenogram calls for a proper interpretation, and the author admits that he finds great difficulty in reading these pictures. The treatment of focal infections must be both local and general, but the fundamental principle is a thorough removal of the primary focus. It is the symptomless tooth with a dental granuloma or blind abscess, devitalized teeth, dentistried teeth with imperfect root canal fillings, that are many times the original focus for secondary infections. Recognition and management of this class of pathologic conditions of the mouth require special study and an educated technic.

The Teeth of Mankind. Editorial. New York Medical Journal, 1919, cx, No. 12, p. 508.

Although the art of dentistry was never so highly developed as at the present day, the teeth of mankind, judging from medical history, were never in such bad condition as now. Comparison with the remote past is especially discouraging in this respect. "Altogether we have some hundreds of skulls from the New Stone Age, that is, of men who used polished and rather well finished stone implements and who lived at least some six or seven thousand years ago. In all these hundreds of skulls there is not a carious tooth to be found. Numbers of these have the enamel worn manifestly by hard chewing, but their healthy dentine had responded well to the pressure exerted on it and had hardened into a resistive vitality that thoroughly protected them. A rather similar state of affairs is found among the Egyptian bodies. None of the children's skulls show any caries of the teeth, though that is to be found among the adults, and it goes without saying that the Egyptian children present much better teeth than the children of our time. It is extremely rare to have to look into the mouth of a child without finding that its first or milk teeth are carious in many places, and sometimes most of them are sadly decayed. Manifestly the trouble is with the habits of mankind in the matter of chewing. Tooth decay has reached such a climax of destructiveness and danger to other structures in the body that it is time to be ready to review the whole subject of the care of the teeth apart from prejudice and customs so as to initiate a movement that will serve to save the teeth of the next generation at least."

A rearrangement of the modern soft and predigested bill of fare, so as to include certain good old-fashioned foods, hard to chew and therefore contributing to the vitality of the gums and purity of the teeth, is recommended as an important step in the right direction.

The Possible Relationship of Dental Abscesses and the Toxemias of Pregnancy. F. M. Loomis. California State Journal of Medicine, 1919, xvii, No. 11, p. 1919.

Chronic dental sepsis is advanced by the author as a possible etiologic factor in the toxemias of pregnancy, on the basis of the reasonable assumption that the irritation of chronic sepsis may be one of the determining factors in lowering the ability of the liver and the kidney to destroy or eliminate the toxins absorbed by the organism. In order to ascertain the frequency of dental abscess and the probabilities of absorption, Dr. W. R. Hughes, of Oakland, at the author's request examined the films of 125 devitalized teeth, with root canals filled, and found 103 abscesses clearly apparent. Dental authorities state that from 50 to 85 per cent of all devitalized teeth are infected. The possibilities for absorption in pyorrhea are evident when it is remembered that the average denture has a circumference of about 30 inches at the gum line. If the patient has pyorrhea with a line of only an eighth of an inch involved, there results an area of 3¾ square inches of infected tissue, where most active absorption can occur. Direct and highly suggestive evidence of the part played by dental sepsis in pregnancy is not lacking, and eight illustrative cases are adduced by the author in support of his argument. On investigating the cases of hyperemesis, pre-eclamptic toxemia and eclampsia on his books, be found practically none without definite dental trouble; and these findings are confirmed by the experience of others. He now insists upon x-ray pictures of all devitalized teeth, and in the presence of definite abscesses has advised extraction in every month of pregnancy up to the ninth under local or general anesthesia, without as yet having had an acute increase of symptoms or a threatened termination of pregnancy. With an undoubted abscess present, he feels justified in the statement that there is less danger in having it out than having it in. However, he does not mean to say that a dental abscess is necessarily the cause of a toxemia just because it is present.

Buccal Hygiene in Schools; Its Importance and Necessity. P. Verissimo. Revista Dental, 1919, xii, No. 9-10, p. 266.

Upon the basis of personal investigations, the author (who is a member of the Faculty of Pharmacy and Odontology in Ceara, Brazil) advocates the establishment of a school dental service, to be maintained by the state. An institution of this kind would render most useful services to the children of the poor, and by improving their health would greatly assist the better development of the human society of the future. The bad results of deficient buccal hygiene are universally conceded by scientific investigators as well as by the governments of all highly civilized countries who have recognized the importance of buccal hygiene by the establishment of school dispensaries and clinics, accomplishing excellent results. Dental service in schools always proves of inestimable value, greatly superior to what would appear at first sight to those who are not trained along this line of observation. The treatment of carious teeth, and the extraction of incurable roots, are highly useful measures in the prevention of tuberculosis, by eliminating dangerous avenues of bacterial invasion and intoxication. The filling of carious teeth serves to remove the lodging places where the tubercle bacillus lives and flourishes,

while this treatment at the same time facilitates an efficient hygiene of the mouth. Accordingly, the practice of buccal hygiene at all ages, as accomplished through appropriate measures of treatment, the filling of carious teeth and the extraction of incurable teeth, constitutes anti-tuberculous prophylactic measures of inestimable value. Tuberculosis, bronchitis, and pneumonia are referable in certain cases to autoinfection of buccal origin, through transmission of the infectious discharges to the respiratory passages. General intoxications often have their point of entrance in the mouth, for the microorganisms of the mouth and their toxins may pass into the circulation, thereby giving rise to grave disturbances. Defective teeth prepare a favorable culture medium for the most dangerous microorganisms which penetrate with the air into the lungs, with the saliva into the stomach, and by way of the lymphatics into the organism. These affections occur especially in the young, because their still growing and delicate body does not offer a strong resistance against infectious diseases. Nowhere more than among school children is there this urgent need of measures of buccal hygiene, for their mouths are as a rule entirely neglected, so that these children become the carriers of microbes which in their turn give rise to contagious diseases, for example, diphtheria.

It is an established fact that children with carious teeth require six months more than the five years usually needed by pupils with healthy teeth for acquiring the knowledge taught in the schools. About forty per cent of the pupils who do not regularly attend school are absent on account of the bad condition of their teeth. In a school in which 190 boys were examined, 937 cavities were found, 450 of which concerned permanent teeth. Of these children, 50 had suffered from scarlet fever in a recent epidemic, and in their teeth, 238 cavities were found. A scarlet fever epidemic in Valparaiso, which lasted over two years, was finally controlled by rigorous dental inspection and care of the mouths of school children, the majority of cases having originated in the schools.

Proper care of the teeth should begin in early infancy and children will derive enormous benefit from instruction in the primary schools as to the maintenance of personal dental hygiene. The school is the suitable point of distribution of hygiene and prophylactic rules, and these lessons will protect the pupils against the constant and repeated toothaches which always leave an injurious and often greatly prolonged impression in the nervous system. A considerable number of cases of epilepsy have been attributed to a pathologic condition of the teeth, acting as a persistent source of irritation. In a general way, it may be said that disturbances of the nervous system are not uncommonly referable to neglected teeth.

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EDITORIALS

Unjust Criticisms of the Teaching of Orthodontics in Schools

NO phase of professional work ever reaches a point that is beyond criticism, neither does it ever attain such perfection that no fault can be found with it. This is true of the teaching of any subject. Criticisms to be of any value should be based upon a careful survey of facts, lest they become unfair. During the past two years it has become a custom among a number of orthodontists and writers to criticize the teaching of orthodontics in dental colleges and postgraduate schools upon every available opportunity. An analysis of these criticisms will show that most of them have been based upon Utopian ideals, which, at the present time, are not practical.

It is well to have ideals, but to be of any use, they must be founded upon conditions as they exist, or they will become as disastrous as the experiments

in government that have been attempted by socialists and other radicals. It seems rather strange that the majority of criticisms of the teaching of orthodontics in dental colleges has come from men who have had practically no experience along this line and who have made practically no investigations as to what is being taught and the conditions possible in dental schools for teaching along the lines they suggest.

One of the most noticeable points brought out by a number of critics is that too much time is given to orthodontics in the dental schools and not enough in the postgraduate schools. In other words, they would shorten the time devoted to the subject in dental schools, and increase that in the postgraduate schools. This seems very illogical. If a student is studying dentistry, why should he not receive certain instruction in orthodontics and thus save considerable time in postgraduate work? The majority of such suggestions come from men who received practically no instruction in orthodontics in dental schools and who spent only a short amount of time in postgraduate work. Many of them have been successful in practice, still they are advocating a course that they did not follow and that is very often entirely impracticable.

We have called attention before to the fact that the great mistake in medical and dental education today is that the courses are being extended over too great a period of time, which means that the student is older than he should be before he is able to enter his profession. Viewing the situation from an economical standpoint, he spends too many years of his life as a nonproducer, consequently becoming a liability to society for a number of years. If to this time a long period for postgraduate work is added, the student continues just that much longer to be a burden to society.

One of the most notable criticisms of the present method of teaching orthodontics was brought out in the presidential address delivered by Dr. B. Frank Gray before the Pacific Coast Society of Orthodontists and published in the August issue of the JOURNAL. The criticisms made by Dr. Gray are very similar to those that have been made for a number of years by men who have stated what they believed or thought to be true but have not made investigations to prove their statements.

Dr. Gray says: "I do not know that any special progress has been made in this department. I believe it is one of the unsolved problems." Of course, in making his claims that there has been no special progress in the teaching of orthodontics, he fails to state over how long a period his observations extend. However, as he states "the suggestions I heard Dr. Angle make a good many years ago are still fresh in mind," we are inclined to believe that his observation must be extending over "a good many years."

In his criticisms he also features certain possibilities as being the solution of the problem of teaching orthodontics, which cover to a certain extent, the visionary ideal, but he leaves out the most important phase of the subject; namely, a faculty with which to teach orthodontics. He calls attention to the possibilities of endowed institutions, but forgets that endowed institutions have probably been the biggest failures in education from every standpoint, because they often feature the endowment and lose sight of the fact that real teaching value in institutions

lies with the men behind the institution. It matters not how fine the building, or how large the endowment, unless there is a good faculty, the student will not learn much in either orthodontics, dentistry, medicine, or law. This is proved by the fact that the large state universities and endowed institutions are not turning out as large a percentage of competent students as are coming from the smaller colleges and private institutions that have faculties capable of turning out men with the ability to accomplish something in life. It would indeed be interesting to know whether Dr. Gray had made investigations of endowed institutions, in any kind of education and compared them with the efficiency of unendowed institutions, universities, and private schools as regards the efficiency of the graduates and those who have accomplished the best things in life. It would also be interesting to know whether he has investigated the postgraduate teaching of orthodontics as it exists at the present time compared with the course he took a good many years ago. From knowledge that we have of the postgraduate situation, we are quite sure that Dr. Gray has not taken advantage of several opportunities to investigate and compare the postgraduate teaching of orthodontics today and a few years ago. We know he neglected to investigate conditions in certain undergraduate schools where special attention is being given to the subject.

It is indeed unfair for any man to make the statement that he does not know of any progress in the teaching of the subject when he has failed to investigate at least a few schools where advances have been and are being made. We know that teachers will invite improved methods, but we contend that improvement certainly has been made over "a good many years ago."

We are also unwilling to admit that the subject *has not been taught* in dental schools and only *attempts* made at teaching it, as one would judge from Dr. Gray's address in which he states: "With all due respects to those who have *attempted* teaching the subject in dental schools, it has so far been a laborious, unsatisfactory proposition." A number of instructors *have taught,* and not only *attempted* to teach it. In a number of schools it has *not* been a laborious unsatisfactory proposition.

Dr. Gray has not taken advantage of the opportunities afforded to investigate this matter, for we know that for a number of years the dental department of the College of Physicians and Surgeons of San Francisco, in which city Dr. Gray is now located, has given postgraduate instruction every year to a number of students. During the time the last course was being given Dr. Gray was invited to visit the institution to familiarize himself with what is being taught at the present time as compared with what was being taught a good many years ago. He did not accept this invitation; still he takes it upon himself to make the statement that *no improvement* has been made. We are calling attention to instruction given in this school especially because it would have been so easy for Dr. Gray to have collected data before he made the unjust criticism which he did make in his presidential address. It would have been very easy if he was going to set himself up as a critic to examine postgraduate instruction as given in other schools in different parts of the country. We would further suggest that he visit such dental schools as St. Louis University, University of Iowa,

Vanderbilt University, and a number of other schools, before he makes such statements.

We do not pretend that the teaching of orthodontics has advanced to the point of being beyond criticism, but we do object to criticism being made by men prominent in society work in such a manner as to be an insult to every teacher of orthodontics in dental colleges today. Criticism is a good thing for any subject, but it must be based on facts and not on false ideas if it is to have any value.

ORTHODONTIC NEWS AND NOTES

The editors desire to make this department a permanent feature of the Journal, but in order to do so must have the full support of the orthodontic profession throughout the country. We would deem it a great favor if our subscribers and readers would send in such announcements as might be of interest to the profession.

Harvey A. Stryker, D.D.S., 317 Cutler Building, Rochester, N. Y., has sent an announcement that his practice will be limited to orthodontia exclusively after the first of January, 1920.

Dr. J. F. McDonald announces the opening of offices for the exclusive practice of orthodontia at Birmingham, Alabama. His offices are in the Empire Building.

Landis H. Wirt, D.D.S., announces the opening of his offices for the practice of orthodontia at 311 Union Trust Building, South Bend, Indiana.

Dr. W. B. Childs announces his location at 706 Candler Building, Atlanta, Georgia, for the exclusive practice of orthodontia.

Dr. Irving Spenadel, 317 East 10th Street, New York City, announces that he will limit his practice to orthodontia exclusively.

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[1]Billings, J. S.: Our Medical Literature, Trans. VII Intern. Med. Congress, Lond., 1881, i, 54-70.

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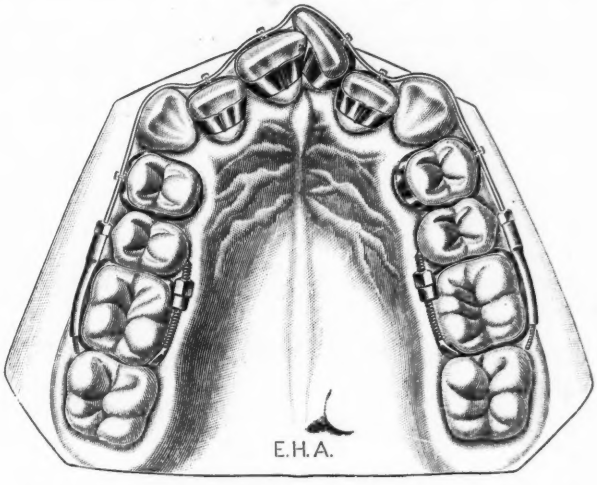

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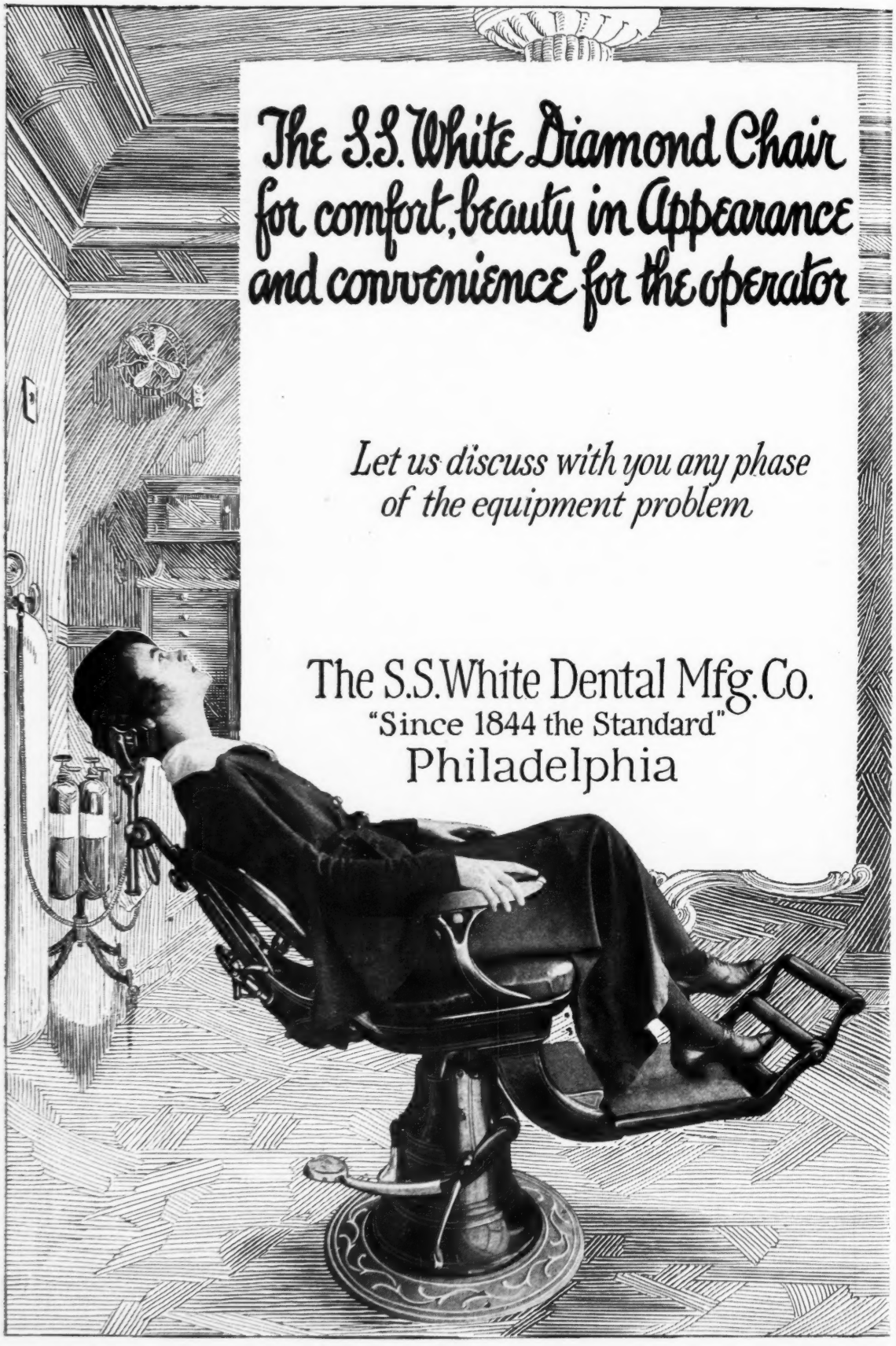
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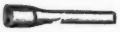

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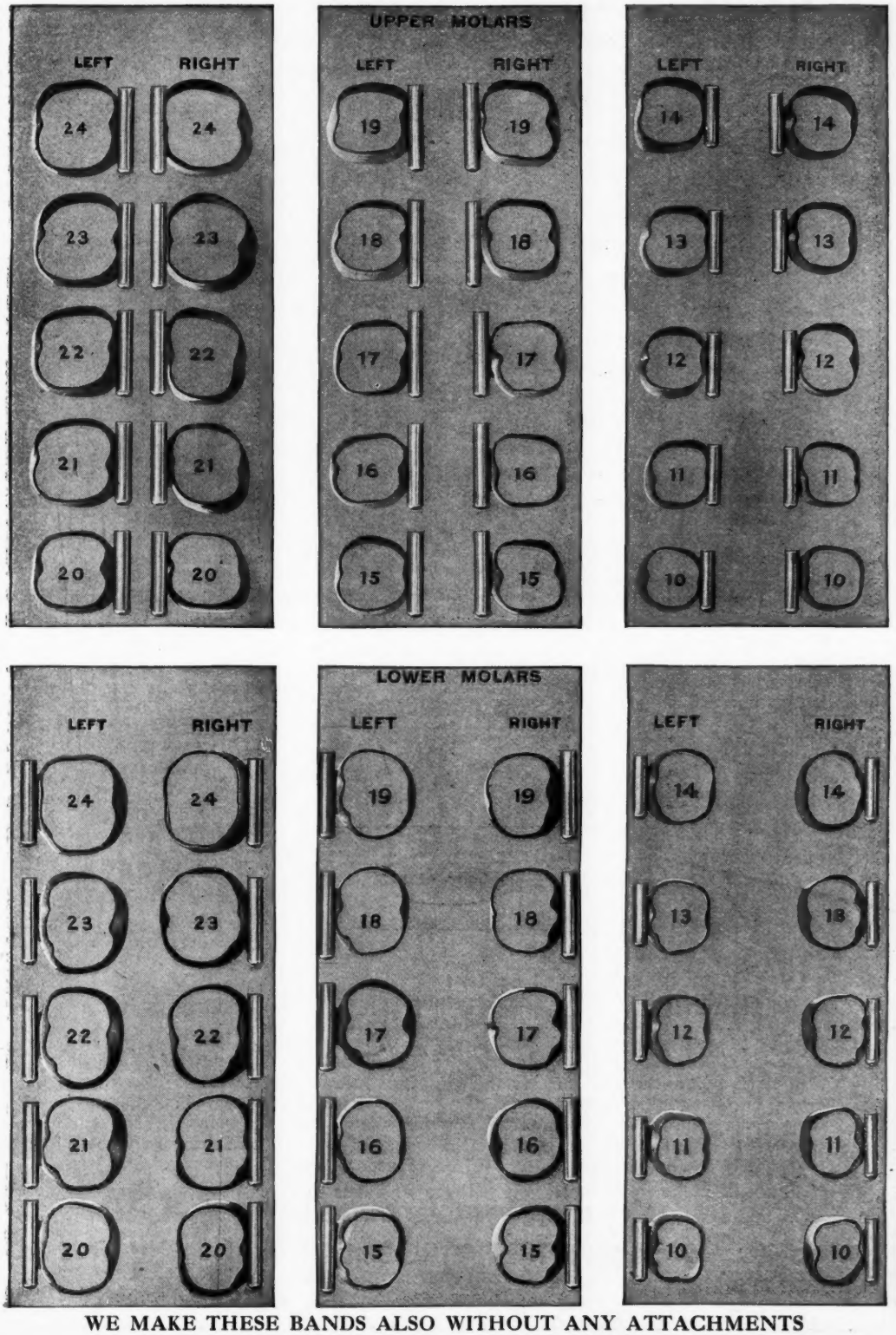

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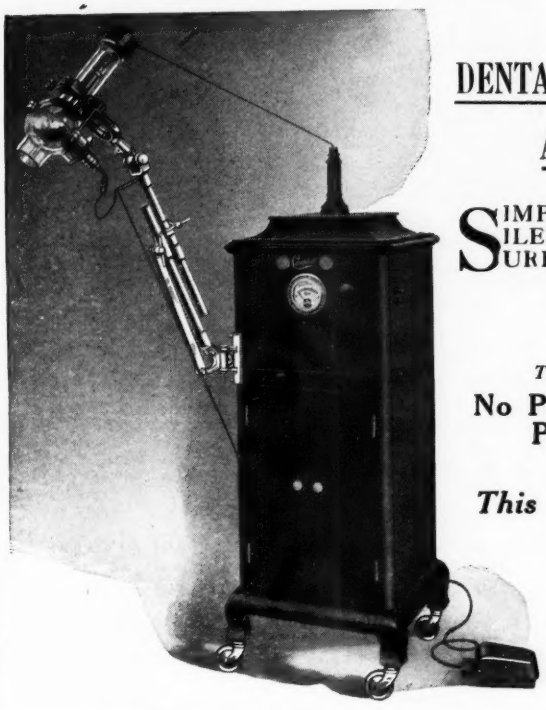
Behind the McK & R Milk of Magnesia are 86 years of scientific laboratory experience. Our oval trademark is a pledge of excellence of formula, purity of ingredients and quality of manufacturing process. *Result:* Increased prestige for you.

If you will make these tests, you will see why it is to your advantage to recommend and advise McK & R Milk of Magnesia as a mouth wash for every patient

91 Fulton Street **McKESSON & ROBBINS, INC.** **New York City**
MANUFACTURING CHEMISTS



THE LAST WORD

IN

DENTAL X-RAY

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SIMPLE
SILENT
SURE

Campbell Coolidge
DENTAL X RAY UNIT

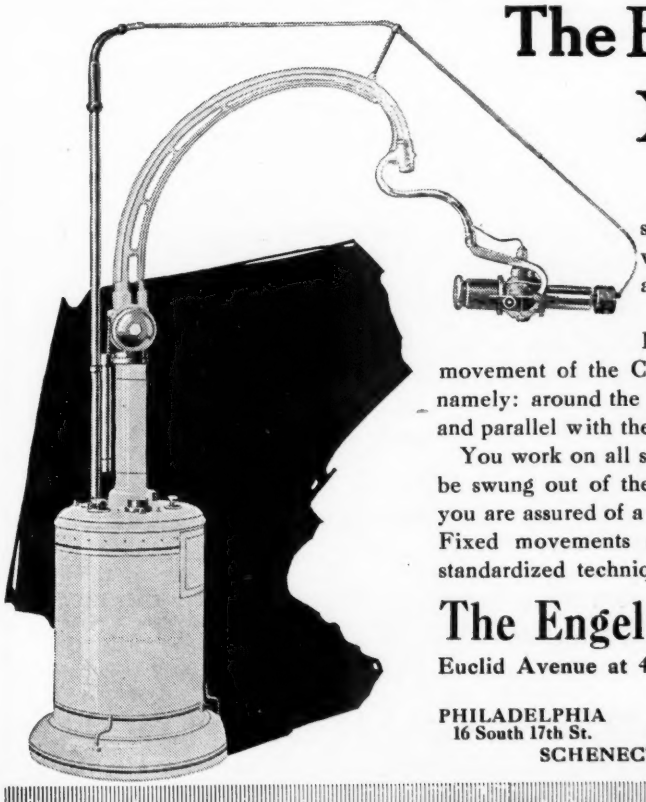
The Result of Years of Combined Research Work

No Preliminary Adjustments, Simply Press Foot Switch and Every Radiograph a Good One

This is One of a Number of Our Dental Models

Sold by reliable dealers, supported by factory service

Campbell Electric Co., Lynn, Mass.



The Engeln Dental X-Ray Unit

Relative angles, duplicate results and speed in dental radiography are attained with this unit, which is built along new and original lines.

The exact requirements for ideal Dental X-ray work are fulfilled by the movement of the Coolidge Tube in three distinct planes, namely: around the jaw, around the long axis of the tooth and parallel with the long axis of the tooth.

You work on all sides of your patient and the arm may be swung out of the way when not in use. With this unit you are assured of a fixed quantity and quality of X-rays. Fixed movements and distances form the basis for a standardized technique.

The Engeln Electric Company

Euclid Avenue at 46th Street **Cleveland, Ohio**

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PHILADELPHIA 16 South 17th St. **DETROIT** 845 D. Whitney Bldg. **PITTSBURGH** 617 Fulton Bldg.

SCHENECTADY **BUFFALO**

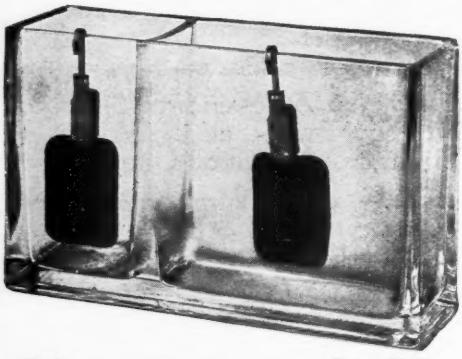
DENTAL X-RAY SUPPLIES

ONLY 2 OF OUR COMPLETE LINE

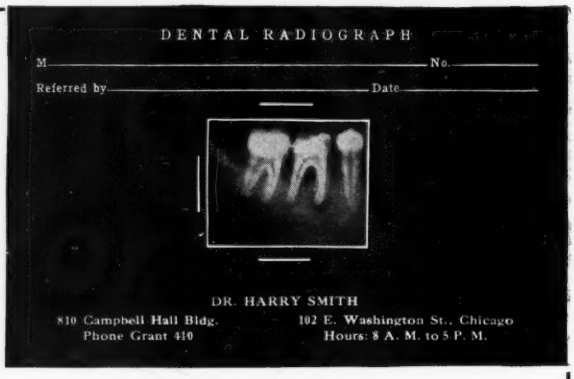
Everything needed for finest dental X-Ray work. Prompt shipment. Low prices—and Technical advice when desired.

DENTAL FILM DEVELOPING TANK

Usually used in pairs—convenient and saves time and chemicals



Tank	Price $1 50
Single Developing Clips, per dozen	1.00
Developer, 20-ounce size	0.30
Acid Hypo Fixing Bath, half-gallon	0.25



DENTAL FILM MOUNTS

Black or Gray Card – with Celluloid Window

Prices include printing with your name, office address, etc.

	Price per 100	200	300	500	1000
For 1 film	$ 3.80	$ 6.25	$ 8.60	$13.00	$25.00
" 2 "	4.50	7.25	10.00	16.00	30.00
" 3 "	5.30	9.00	12.50	18.50	33.00
" 4 "	7.00	12.50	17.00	25.50	48.00
" 5 "	9.00	16.50	24.00	33.50	65.00
" 10 "	13.50	24.00	34.00	54.00	100.00

WE CARRY ALL SIZES OF

Dental X-Ray Films and X-Ray Plates in stock for quick shipment, also a wide line of other X-Ray supplies.

Send for complete price list with discount sheet.

GEO. W. BRADY & CO.

780 SO. WESTERN AVE. CHICAGO

To make the best radiograms with the Adams Unit, all you need to know about electricity is

"PUSH THE BUTTON"

It is Automatic

The Adams Dental X-Ray Unit

with

Coolidge Dental Tube

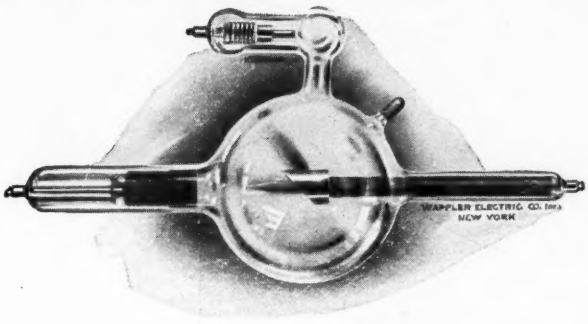
Our catalogue tells how guess work is replaced by positive conditions, it shows why our customers secure "BETTER RADIOGRAMS" from the first day.

THE ADAMS X-RAY COMPANY

WOODWARD & SEWARD AVES. DETROIT, MICH.

ANNOUNCEMENT

AN EPOCH-MAKING ADVANCE IN THE ROENTGEN ART



The Wappler Electric Company announces the production of a new Roentgen Ray Tube known as

NITROKEN

This new gas tube remains stable during heavy prolonged exposures and cannot be over-reduced. Full technical and commercial information will be sent upon request

WAPPLER ELECTRIC COMPANY, Inc.
173 East 87th Street, NEW YORK, U. S. A.

H U S H !

This is the "Baby Hogan"
SILENT
Dental X-Ray
Transformer

Patented Jan. 30, 1917

Perfect Dental Radiographs
The Refined X-Ray Equipment
No Motor or Moving Parts on A.C.

SOLD BY ALL LEADING JOBBERS

You buy only one X-Ray machine. Here's your chance to own the best at the lowest possible outlay.

FREE! A beautiful catalog showing the "Baby Hogan" in natural colors. Send for your copy today.

"If you want a thing done well, do it yourself."

BE AN X-RAY Specialist yourself.

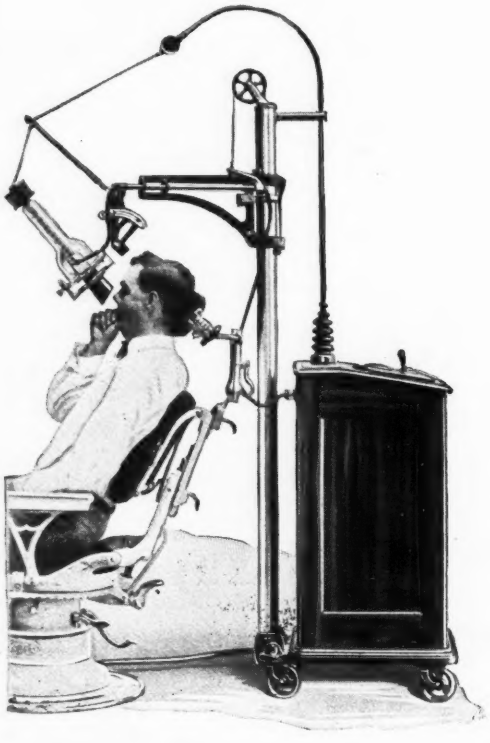
McINTOSH BATTERY & OPTICAL CO.
217-223 N. Desplaines St., Chicago, Ill.

COUPON

Name.....

Address.....

VICTOR



A Dentist Need Never Apologize

for his x-ray work, nor for the appearance of his equipment if he has a "VICTOR"

Victor Service plus Victor Quality vouch for this

VICTOR ELECTRIC CORPORATION
Dental Department
Jackson Blvd. and Robey, Chicago

Mention this Journal when writing to Advertisers.

Silvol in Dental Practice

SILVOL, a colloidal proteid-silver combination, is being successfully used by dental practitioners in the treatment of pus cavities and infected tracts of the oral cavity. It is also employed in five- to ten-per-cent solutions for swabbing sockets after extraction.

A ten-per-cent solution of Silvol is being used in the treatment of pyorrhea. After instrumentation it is applied by means of a glass syringe equipped with a dental applicator. The pus pockets are first washed with warm water, dried, flooded with the solution of Silvol, and the latter allowed to remain for five minutes. The mouth is then rinsed with warm water. This treatment is repeated daily.

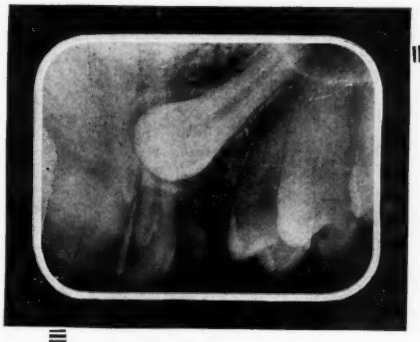
Silvol does not coagulate albumin. It will not stain enamel or hands if washed off after use.

SILVOL CAPSULES, 6 GRAINS.

The contents of one capsule added to two fluidrachms of water makes a five-per-cent solution of Silvol.

Supplied in bottles of 50 and 100.

Parke, Davis & Company



TRADE MARK
X-OGRAPH
REG.

X-Ograph Packets

FOR DENTAL X-RAY WORK

The Perfect Dental Film Packet

SEVEN ADVANTAGES

1. Extremely Thin With Smoothly Rounded Corners
2. Permits a Record on the Back of Each Packet
3. Special Metal Back Increases Detail and Contrast
4. No Secondary Rays Means Clearer Definition
5. Less Tendency to Nauseate the Patient
6. Readily Conforms to the Curvatures of Mouth
7. Easily Placed and Held in Position

X-Ograph Packets Will Improve Your Dental X-Ray Work

BUCK X-OGRAPH CO.

SOLD THROUGH DEALERS ONLY ST. LOUIS, MO.

DOCTOR
when you think of
X-RAY
think of
EDWARDS
when you buy an
X-RAY
buy an
EDWARDS
and be assured of
Service and Satisfaction

Ask your dealer or any user

EDWARDS
X-RAY MANUFACTURING CO.

Main Office and Factory
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INDIANAPOLIS, - - U. S. A.

CLOVER LEAF

X-Ray Tubes for
Transformers
Induction Coils
High Frequency Coils

X-Ray tubes repaired and rebuilt

Green & Bauer, Inc.
30 E. Randolph St. Chicago, Ill.
234 Pearl St. Hartford, Conn.

READING YOUR X-RAY
PICTURES IS MADE EASIER BY THE USE OF
"COLUMBIA MAGNIFYING RADIOSCOPE"

The "explanation window" enables you to explain the diagnosis to your patient by means of a pointer, at the same time as your patient is viewing the magnified Radiograph. With the new Radioscope, Mounts of all sizes including Dental Series of entire mouth can be examined and explained.
Equipped with a rheostat, to vary the amount of light, the model illustrated permits you to examine correctly the thin as well as dense negatives, by simply decreasing or increasing the intensity of light, so as to bring out the finest details.
More than a thousand progressive dentists are using the Columbia Magnifying Radioscope. Your patients, too, will appreciate its great advantages.

Ask your dealer to demonstrate the new instrument

Cat. 119R as illustrated with light intensity regulator . . **$35.00**
Cat. 119L without rheostat . . . **$25.00**
Mounted either on floor stand or wall bracket, additional . **$10.00**
These instruments operate from a 110 volt lamp socket.

Columbia X-Ray & Electric Corp.
131 East 23rd Street
NEW YORK

RADIUM SERVICE
by
The Physicians Radium Association of Chicago
Established to make Radium more available in the Middle States. Has *the* large and complete equipment that enables it to provide with the greatest possible precision for any case in oral surgery in which Radium Therapy is indicated. Invites any responsible physician to avail himself of its Service. Radium sent out, or treatments may be referred here. Moderate rental fees charged.

THE PHYSICIANS RADIUM ASSOCIATION
1104 Tower Building CHICAGO 6 N. Michigan Avenue
Managing Director: Albert Woelfel, M.D.
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Mention this Journal when writing to Advertisers.

If you are looking for X-ray efficiency in Orthodontia—a machine which will make films of the teeth and plates of the jaw and head quickly and with the finest detail—

Fischer Universal

Interrupterless Transformer No. 2A

H. G. Fischer & Co.

2335-43 Wabansia Ave.
Chicago, Ill.

will answer your every requirement

Plenty of power for *all* work—*any X-ray tube*—small, compact, and easily moved—the last word in "pep."

Champion Traction Cord
For
Teeth Regulation

ACCEPTED by the leaders in orthodontia work as perfect in principle and effect.
Champion Traction Cord is made of pure silk so constructed that it shrinks GRADUALLY. Wire lacks this necessary quality; hence it is only a makeshift. Hemp and other fibres shrink very rapidly—a bad fault. Champion Traction Cord shrinks over a period of many hours, drawing the teeth steadily and gradually.

Packed in 50 yard glass containers with patent nickel-plated cut-off—very efficient. Price $1.45 each.

If your supply dealer does not carry this send his name and your order to us.

GUDEBROD BROS. SILK CO.
603 Chestnut Street
Philadelphia, Pa.

Caulk Zinc Cement
—plus Copr-Zinc

Setting a crown or a bridge is the final step of an exacting dental operation. It is designed to last for years. The patient expects it to and you assure him so. The anchoring cement is your only insurance against failure.

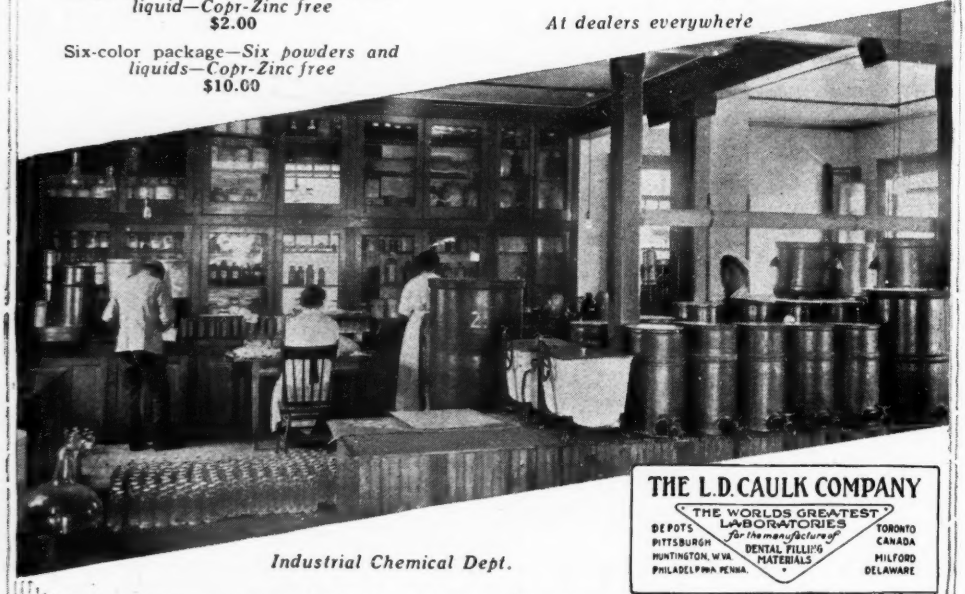
Caulk Zinc Cement —plus Copr-Zinc
is preferred insurance

It mixes smoothly, velvety, without hurry, without worry. Three and four post abutment canals can be carefully filled and the bridge accurately placed before initial hardening begins. *Caulk Cements—plus Copr-Zinc*—protect the abutments against recurrent decay. They anchor crowns and bridges immovably—permanently.

Single color package—*one powder and liquid—Copr-Zinc free*
$2.00

Six-color package—*Six powders and liquids—Copr-Zinc free*
$10.00

At dealers everywhere



Industrial Chemical Dept.

THE L.D.CAULK COMPANY
THE WORLDS GREATEST LABORATORIES for the manufacture of DENTAL FILLING MATERIALS
DEPOTS PITTSBURGH HUNTINGTON, W.VA. PHILADELPHIA PENNA.
TORONTO CANADA MILFORD DELAWARE

A REQUIREMENT of great importance in the mechanical administration of nitrous oxide-oxygen anaesthesia is an accurate measuring device which will insure absolute control and a definite even flow of gases.

The only dependable device known to cover such requirement is a meter—and meters are the special features of the Connell Gas Oxygen Apparatus.

Another important feature of the Connell Gas Oxygen Apparatus is the drop method of ether introduction through a sight feed conveniently located between the two meters so that the rate of gas flows and ether drops are all seen within the radius of two inches.

The Connell Gas Oxygen Apparatus was adopted by the U. S. Government and Red Cross after a series of severe Competitive tests.

Write us for a list of owners in your vicinity or call on your dealer for a copy of our booklet "Scientific Anaesthesia".

If his supply is exhausted, we shall be glad to send one direct.

Scientific Apparatus Co.
162 West 34th Street
New York City

Connell Gas-Oxygen Apparatus

Try Pepsodent

Ask Us to Send a Tube

It contains activated pepsin to act on the albuminous plaque.

It contains tricalcic phosphate—a polishing agent uniquely efficient. Yet natural teeth have been brushed with it 200,000 times without harm.

It is acid in reaction, so it stimulates the flow of alkaline saliva.

It contains no soap, for soap is alkaline.

Pepsodent is bringing about a new era in oral hygiene.

Five years of clinical and laboratory tests have confirmed every expectation.

It now has at least a million users, due largely to dental endorsement.

150,000 people monthly write us for sample tubes.

Every dentist should prove it for himself.

Pepsodent PAT. OFF. REG. U.S.

Dental Mucin Digestant

Based on activated pepsin

Contains no soap, no chalk

254

THE PEPSODENT COMPANY,
5107 Ludington Bldg., Chicago, Ill.

Please send me, free of charge, one regular 50c size tube of Pepsodent, also literature and formula.

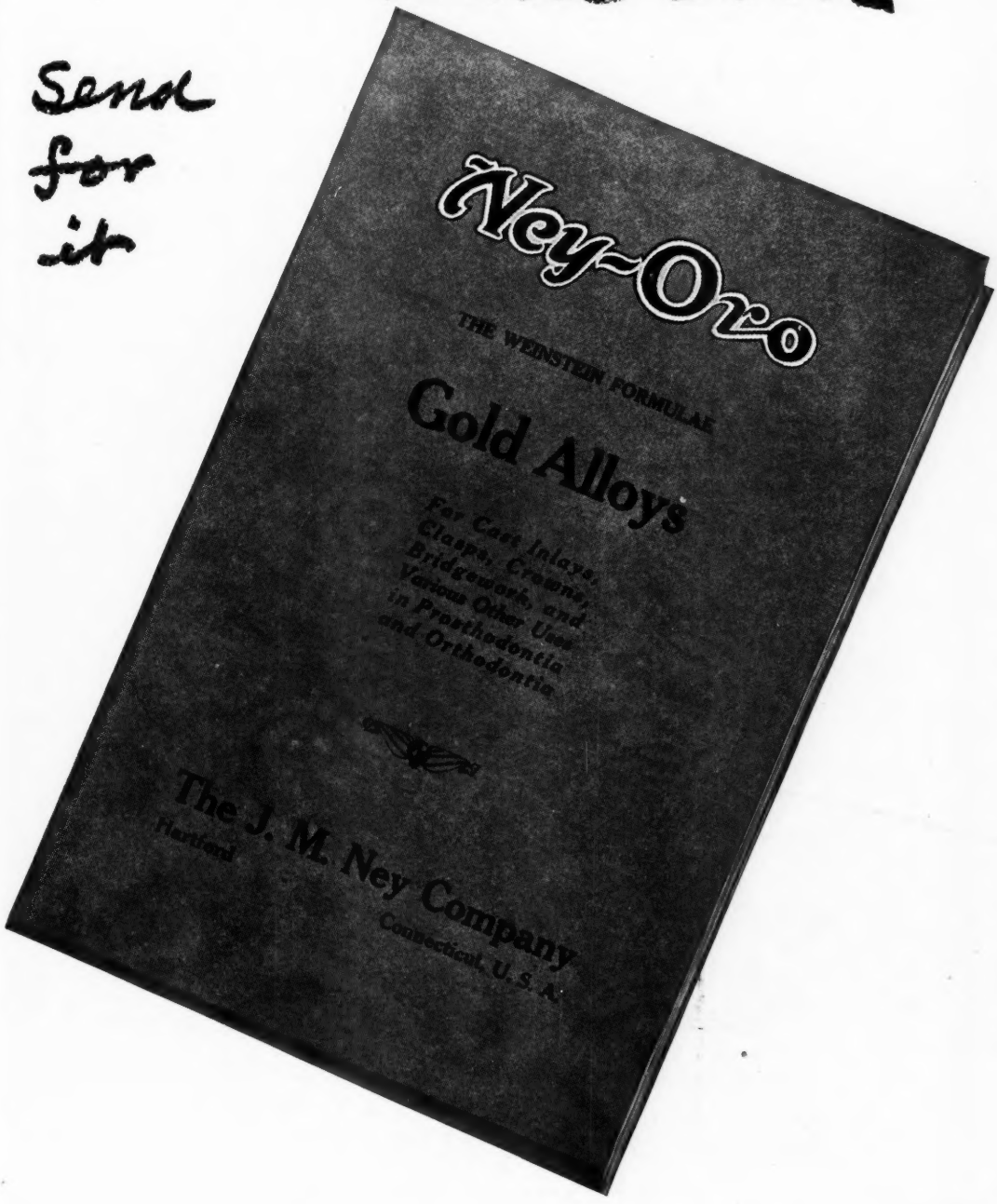
Name .....

Address .....

Enclose card or letterhead

You need this little book

Send for it


Ney-Oro
THE WEINSTEIN FORMULAE
Gold Alloys
For Cast Inlays, Clasps, Crowns, Bridgework, and Various Other Uses in Prosthodontia and Orthodontia
The J. M. Ney Company
Hartford
Connecticut, U. S. A.

Are Your Patients Comfortable?

TO make your patients comfortable you must use an Operating Chair built on right principles, one that does not require you to make complicated adjustments for each occupant.

The Ritter Chair is designed to meet anatomical requirements. Placed in the standard operating position, raising or lowering the head rest is the only change necessary for ordinary work.

Other adjustments when required are made by a slight touch on the lock levers—no catches to unfasten—no wheels to turn.

RITTER CHAIR
Standard Position

It almost adapts itself to a position which is comfortable both to yourself and your patient.

Ritter Dental Mfg. Co., Inc.

Rochester, N. Y.

New York *Chicago* *Philadelphia* *Boston* *Kansas City*

Mention this Journal when writing to Advertisers.

KOLYNOS

ADDITIONAL USES

No. 2

In Prophylaxis, when cleaning the teeth with pumice, use Kolynos Dental Cream as a binder or add Kolynos to the brush at the end of the operation. The patient will comment upon the pleasant and refreshing condition of the mouth. The antiseptic and disinfecting properties are additional reasons for its application.

Upon request a dental package of Kolynos will be gladly sent, charges prepaid.

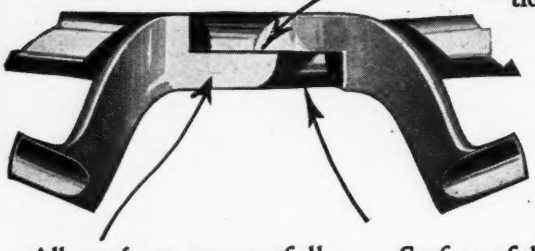
THE KOLYNOS COMPANY

NEW HAVEN - - - - - - CONN.

Ten Very Good Reasons Why You Should Use Clev-Dent Forceps With *Bi Sur* Joints

REG U S PAT OFF

The *Bi Sur* Joint has only two friction surfaces, instead of four.

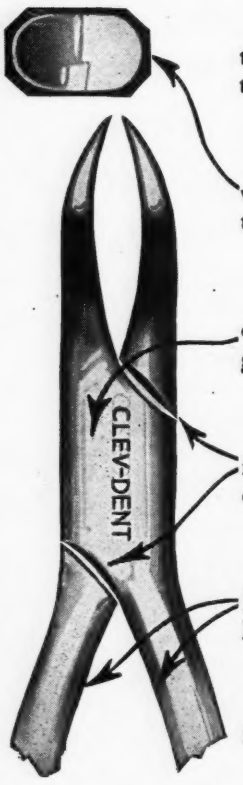


All surfaces are carefully polished and nickel-plated, including those not generally finished.

Surfaces of the *Bi Sur* joint are more accessible for cleaning. Sterilization is easier and more certain.

Even distribution of material between the two sides of the *Bi Sur* joint. Less bulk and greater strength.

The slender joint does not obscure the operator's view of the field of operation.



Rounded surfaces of the *Bi Sur* joint (shown in comparison with the box joint) reduce the size and make it possible to use the forceps where it could not otherwise gain access.

The lock of the *Bi Sur* joint has twice the bearing surface of other joints. Tests for strength show at least thirty per cent greater resistance to strain.

Joints so carefully beveled that it is impossible to pinch the patient's cheek or the operator's hand.

Handle beveled where force is applied. No sharp edges to bruise the operator's hand.

Swell end handles protect the palm increase force, facilitate control.

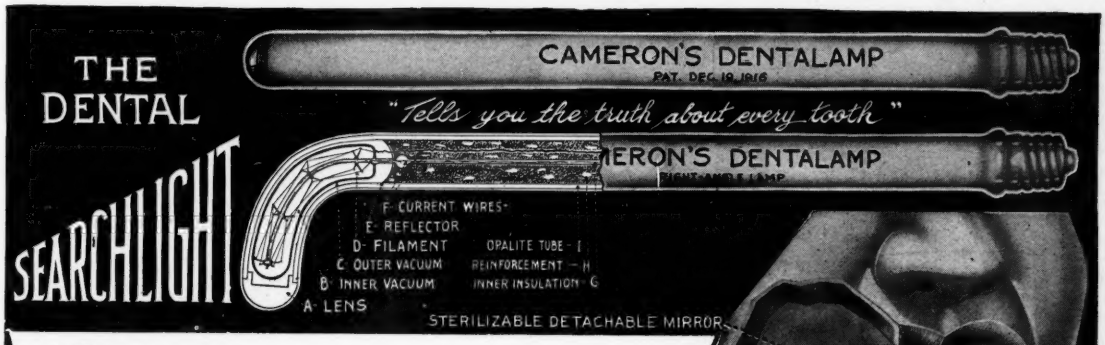
Forceps with *Bi Sur* Joints are made only by

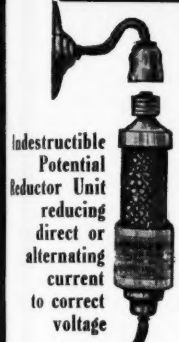
The Cleveland Dental Manufacturing Company

Cleveland, Ohio, U. S. A.

Manufacturers of Dr. Winter's Standard Forceps and other instruments for Exodontia and Oral Surgery.

Mention this Journal when writing to Advertisers.





Indestructible Potential Reductor Unit reducing direct or alternating current to correct voltage

More than 6000
Careful Dentists Everywhere
Use and Endorse

CAMERON'S DENTALAMP

Because it is the only clean, cool, white Mouth Mirror Lamp giving efficient and economical service.

These dentists are no longer satisfied with unsanitary, unsterilizable metal handle outfits, and they condemn the use of these for they constantly expose healthy patients to active infection.

The wonderful searchlight principle shown in cross section cut above makes possible correct diagnosis of Abscessed Teeth, Infected Antra and Frontal Sinuses. Healthy tissue is clearly trans-illuminated and all focal infections are outlined by heavy shadows.

The double vacuum (like a Thermos bottle) assures coolness.

The Opalite tube is clean and white, and prevents electric shock.

Special attention is directed to the Right Angle Dentalamp which is correctly curved for trans-illumination and extraction of posterior teeth.

The Koolite Model (illustrated below) may be readily attached to any electric light socket. Two Right Angle and two Straight Dentalamps are supplied so one set of lamps may be kept in sterile solution.

A BETTER LAMP FOR DENTAL USE CAN NEVER BE MADE.

SIGN AND SEND FOR TRIAL OFFER TODAY.

American Surgical Specialty Company
State and Lake Sts., Chicago, U. S. A.

Send me CAMERON'S DENTALAMP for ten day's trial (Koolite Model, to include Potential Reductor Unit, eight feet of cord, two straight Dentalamps, two right angle Dentalamps, two detachable mirrors and all necessary connections, in leatherette carrying case). Enclosed find check for $25.00 to be returned in full and immediately if not entirely satisfactory to me.

Name .....

Town and State.....

Sherman's
Bacterial Vaccines

Preparations With A Record For
EFFICIENCY

In the treatment of mouth infections, Bacterial Vaccines are now recognized as most efficient remedies. This will include mandibular, septic apical and dento-alveolar abscesses, and pyorrhea. Sherman's List No. 40 or 35 are admirably adapted for these uses.

Sherman's New All Glass Syringe
An Unusual Value, Price $2.00
Two Platin Needles, Self-Sterilizing Cap over Needle and Metal Case

Patent Applied for

Write for Literature

G. H. SHERMAN, M. D. DETROIT, U. S. A.

A New and Timely Book

Roentgen Diagnosis Of Diseases Of The Head

By **Dr. Arthur Schüller**, Head of the Clinic for Nervous Diseases at the Franz-Joseph Ambulatorium, Vienna.

Authorized translation by **Fred F. Stocking, M.D., M.R.C.**, U. S. Army. With foreword by Ernest Sachs, M.D., F.A.C.S., Associate Professor of Surgery in Washington University Medical School.

310 pages, with 97 original halftones, line drawings and radiographic illustrations. Price, silk cloth, $4.00.

"The text is interesting and profitable, and the difficult subject of intracranial diagnosis is very much furthered by the appearance of this work which offers, for the first time, a comprehensive and complete resume of the extremely scattered literature on the subject."—*New York Medical Journal.*

☞You should have a copy of this book in your library.

C. V. Mosby Company, ***Publishers***
Metropolitan Building **St. Louis, U. S. A.**

A Timely Book For The Dentist

Systematic Development of X-Ray Plates and Films

(Including Lantern Slide Making)

By **Lehman Wendell, B.S., D.D.S.**, Chief of the Photographic Work and Instructor of Prosthetics and Orthodontia, College of Dentistry, University of Minnesota, etc.

80 pages, with 40 original illustrations. Price, silk cloth binding, $2.00.

This new work takes up in detail the development of x-ray plates and films. It covers such subjects as Methods of Development, Developing Formulas, Fixing Bath Formulas, Plate Washing, Negative Drying, Alternation of Negative by Chemical Means, Developing Tanks, Controlling Temperature of Solution, Dark-Room Aids. The text is elucidated with forty helpful illustrations.

☞Order this book from your x-ray dealer, dental depot, book-seller, or direct from the publisher. Also ask for circulars of other new x-ray books.

THE C. V. MOSBY COMPANY, ***Publishers***
801-809 Metropolitan Building **St. Louis, U. S. A.**

Washington University School of Dentistry

(Missouri Dental College)

The Fifty-fourth Annual Session will begin September 25th, 1919, and continue thirty-two weeks exclusive of holidays.

This institution offers co-educational advantages in a four-year graded course of Dental Instruction second to none in America.

Thorough training in the fundamental sciences of the first year right on the campus, where teaching facilities are unsurpassed.

We particularly desire young men and women of broad general education, as Dentistry offers them unusual opportunities. This institution offers special facilities for general training in this profession.

Beginning with the fall session of 1921, one year of prescribed college work will be required for matriculation.

Classes limited to fifty students each. Write today for full information. Address

THE DEAN,

29th and Locust Streets, ST. LOUIS, MO.

ORTHODONTISTS

We can supply you with your requirements in

PRECIOUS METALS

WIRE

15% Iridium Platinum Wire—Foot lengths—All gauges.
High Fusing Platinum and Gold Wire—Foot lengths—All gauges.
Regular Grade Clasp Wire, " " " "
18-20-24 Karat Gold Wires, " " " "

BAND MATERIAL

5-10-15% Iridium Platinum, all widths and thickness. Platinum Sheet, all widths and thicknesses. Coin Gold Bands, all sizes.

Anything in Precious Metals or their alloys.

Send us your Gold and Platinum Scraps, Filings, etc., to be refined and exchanged for new material.

THOMAS J. DEE & CO.

Refiners and Workers of Precious Metals

Sales Office
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Works
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KERR

EX-O-DENT

REG. U. S. PAT OFF

CHEWING GUM

A Pure, Hard Chewing Gum

Recommended by dentists and especially prepared for their patients.

One of the numerous recognized causes of irregular teeth in children and soft gums or pyorrhea in older people is the lack of sufficient exercise of the jaws and teeth due to eating soft and soaked foods.

The chewing of Kerr Ex-O-Dent Chewing Gum furnishes the much needed exercise and actually aids development.

The gum is so hard that the patients' jaws become tired in 15 or 20 minutes, when chewing should be discontinued.

Price per box (containing 6 packages of 5 sticks).....$0.50

DETROIT DENTAL MFG. CO., Detroit, Michigan, U.S.A.

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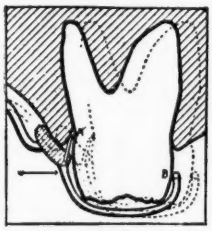
DR. BACON'S REMOVABLE REGULATING APPLIANCE



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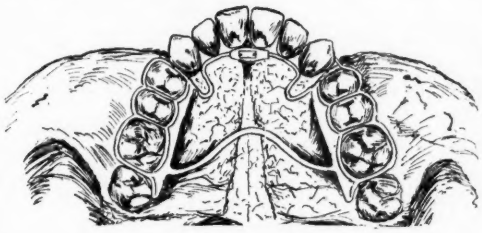

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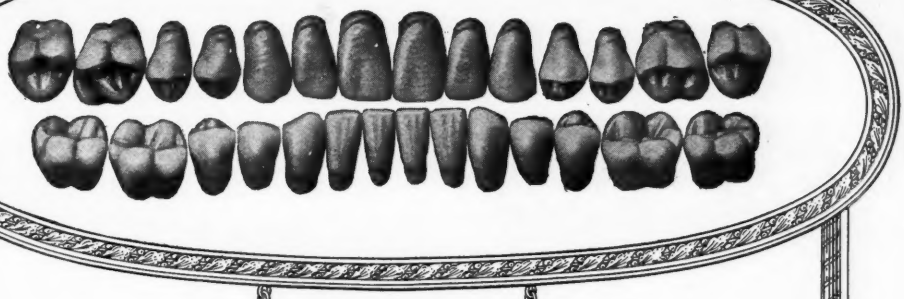

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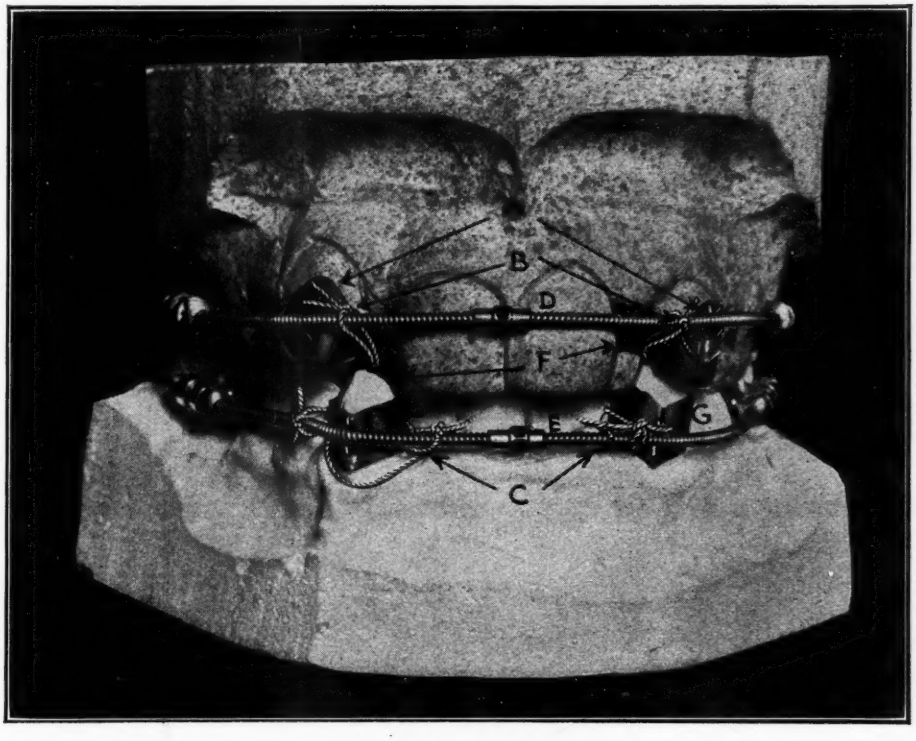

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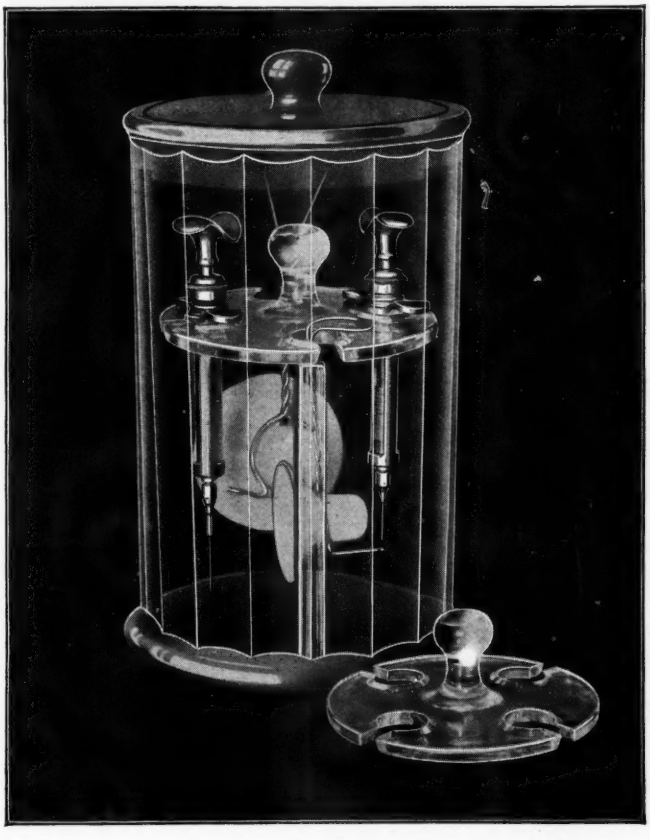

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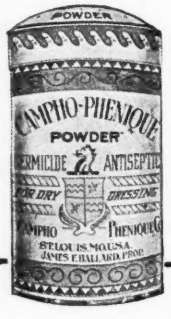

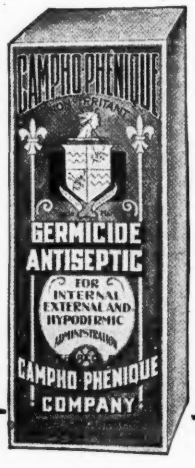

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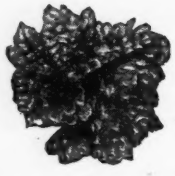

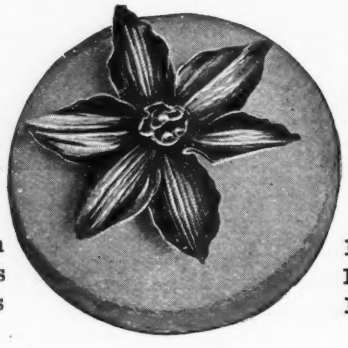

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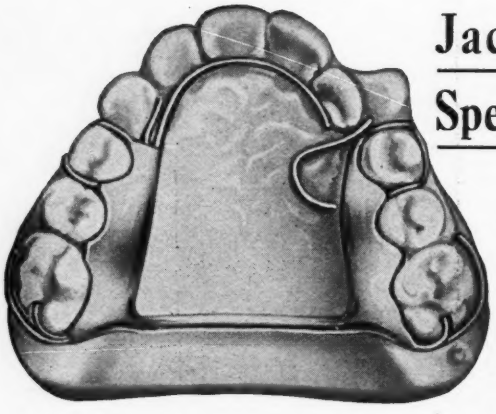

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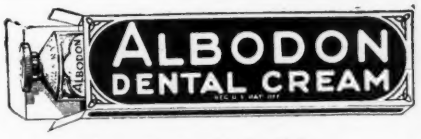

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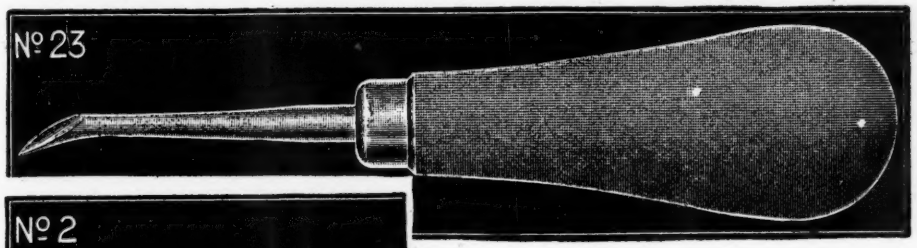

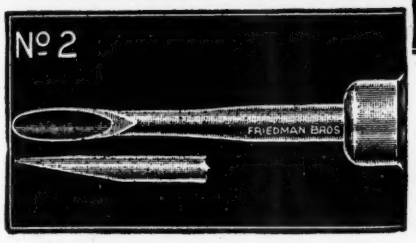

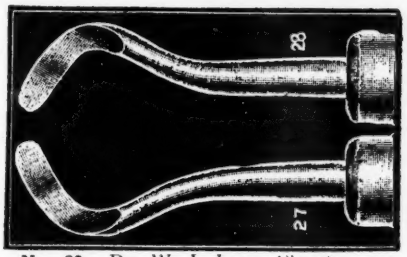

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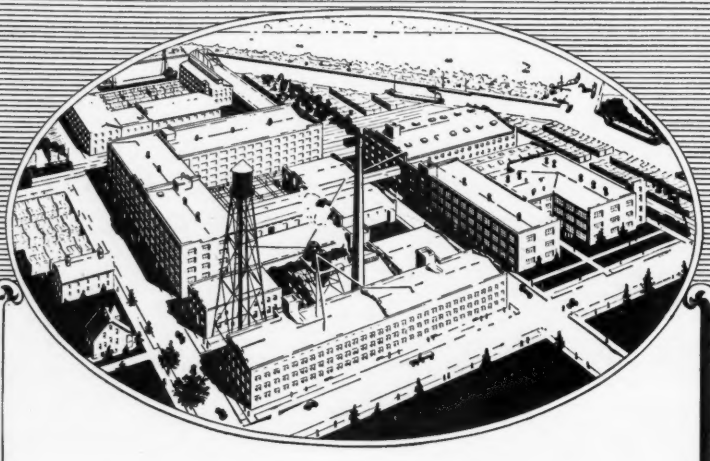

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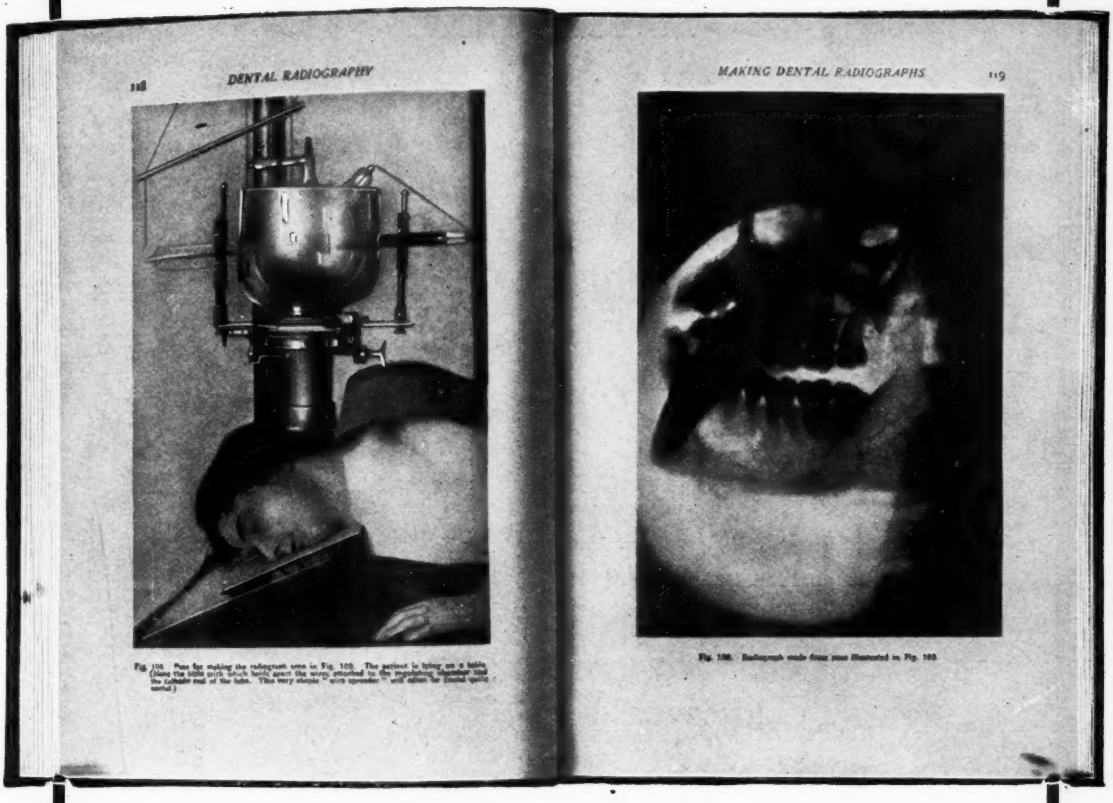

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Martin Dewey, D.D.S., M.D., Chicago
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